Biological Review
of the

Regional Road Maintenance
ESA Program Guidelines

Developed by:

Regional Road Maintenance

Technical Working Group

December 2001
August 2003 updated

Contents

Tables

Figures

Appendices

Table C-2: Common Task Descriptions for Road Maintenance Activities

1.0 Summary

The purpose of this Biological Review (BR) is to determine if adoption of the Regional Road Maintenance ESA Program (Regional Program) will appropriately conserve salmonid species listed as "threatened" under the Endangered Species Act (ESA). Such a finding would enable the local governments within Washington State, as well as the Washington State Department of Transportation (WSDOT), to obtain a "take limit" from the National Marine Fisheries Service (NMFS). Obtaining a take limit would allow agencies to continue road maintenance operations, conserve aquatic species, and avoid being subject to the 4(d) rule's prohibition on take.

Species under NMFS' administration that are candidates for listing under the ESA, as well as species listed as threatened under the jurisdiction of the United States Fish and Wildlife Service (USFWS), have been included in this BR to allow for future consideration for take limits (NMFS), and/or reductions or eliminations of the prohibition on take of threatened species (USFWS).

1.1 Objectives of the Biological Review

As part of their review and approval process, NMFS is required to evaluate the Regional Program from a biological perspective to determine if the program adequately contributes to conservation. This BR was prepared to provide a basis for the NMFS biological evaluation of the Regional Program.

For the Regional Program to qualify for a take limit under 10(ii) of the 4(d) Rule, the BR must conclude that the Regional Program appropriately conserves threatened salmonids by contributing to properly functioning conditions for road maintenance activities in Washington State. To that end, the BR describes the scope of road maintenance activities in Washington, the Regional Program, the status of the threatened species, and the present environmental baseline in the State. The BR assesses effects of road maintenance activities on threatened species, and places those effects in the context of all activities that contribute to the environmental baseline. In so doing, the BR compares the environmental effects of the Regional Program to the effects that could result without implementation of the Regional Program. This analysis could also be used by USFWS to determine whether or not the take prohibition for threatened species (such as bull trout and SW Washington/Lower Columbia River Coastal Cutthroat Trout) could be reduced or eliminated.

This BR applies to the activities described in the Regional Program in the entire state of Washington. The BR focuses on threatened fish species listed under NMFS jurisdiction, but could also be used in the future by USFWS to determine if the prohibition on take of threatened species could be reduced or eliminated. The Biological Subcommittee of the Regional Forum prepared the BR. The subcommittee is chaired by a biologist from WSDOT, and included ecological and road maintenance experts from a number of participating agencies.

1.2 Background

In May 1999, NMFS proposed the listing of the Puget Sound Chinook salmon as "threatened" under the Endangered Species Act of 1973. In response to the proposed NMFS listing, as well as the December 1999 United States Fish and Wildlife Service (USFWS) listing of the bull trout as threatened, local governments in the Puget Sound region formed a coalition, known as the "Tri-County ESA Response Effort." The Tri-County ESA Response Effort identified several government agency programs with the potential to contribute to the conservation of listed salmonid species. Road Maintenance is one of these programs.

Under the Tri-County Response Effort, the Tri-County Road Maintenance ESA Technical Working Group, a team of local road maintenance managers and technical staff, was formed. The mission of the Tri-County Road Maintenance ESA Technical Working Group was to develop a road maintenance program that would contribute to the conservation of salmonids and other fish species and would meet federal agencies' requirements under Section 4(d) of the ESA. At the same time the Tri-County effort was getting underway, WSDOT was beginning to develop its own road maintenance program, with the same goals as the Tri-County Road Maintenance ESA Technical Working Group.

The Tri-County Road Maintenance ESA Technical Working Group quickly expanded to include counties and cities outside the Tri-County area of Pierce, Snohomish and King counties. WSDOT also became an active and vital member of the group. The group was renamed the Regional Road Maintenance Technical Working Group to reflect a growing interest and participation in the program. In the fall of 2001, after 2 years of collaborative effort developing the Regional Program and the WSDOT road maintenance program, WSDOT chose to formally consider their program part of the Regional Program. This decision expanded the Regional Program to include the entire state of Washington.

To assist local governments in implementing the program, and to provide NMFS with a thorough document against which Regional Program compliance could be evaluated, the Technical Working Group developed the *Regional Road Maintenance ESA Program Guidelines (Guidelines).* By following the *Guidelines*, when doing road maintenance work, local agencies will contribute to conservation of aquatic species listed under the ESA. Road maintenance activities, when conducted in accordance with the *Guidelines*, can achieve desired "conservation outcomes." NMFS, USFWS and other regulatory authorities, as well as Puget Sound area tribes, environmental interest groups, and business groups, provided input and assistance in the development of the Guidelines.

The collaborative effort to develop the Regional Program was extensive. A full year of development and review of the program had been completed by July 2000 when NMFS adopted a rule under section 4(d) of the ESA (65 Fed. Reg. 42422; 50 C.F.R. 223.203) prohibiting the "take" of 14 groups of salmon and steelhead listed as threatened under the ESA. The 4(d) Rule also describes limitations on the prohibition of take to certain state and local programs in 13 specific categories, including Routine Road Maintenance (Limit 10). Limit 10 provides that routine road maintenance activities conducted by the employees or agents of a state, county, city, or port in a manner that has been found to contribute to properly functioning conditions are eligible for the limitation on the definition of "take" of threatened species.

The *Guidelines* containing the Regional Program were formally transmitted to the NMFS and USFWS (the Services) in December 2000. The Regional Program is intended to serve as a model program that, if approved, local jurisdictions throughout Washington State could adopt and implement to qualify for a take limit under the 4(d) Rule (NMFS), and/or a reduction or elimination of the prohibition on take of threatened species (USFWS).

As early ESA conservation actions, many local jurisdictions began implementing the Regional Program in advance of formal approval by the Services. Program Element 1 of the Regional Program calls for creation of a Regional Forum to manage Regional Program implementation across the state. After formal submittal of the Regional Program to the Services, the Regional Road Maintenance ESA Technical Working Group was designated as the Regional Road Maintenance ESA Forum (Regional Forum). Within the Regional Forum, technical subcommittees were formed to address a wide variety of program goals.

1.3 Purpose

The purpose of the *Regional Road Maintenance ESA Program Guidelines* is to provide a Regional Program that can be used by any agency wishing to seek a take limit under the 4(d) Rule (NMFS), and/or a reduction or elimination of the prohibition on take of threatened species (USFWS).

The Regional Program is comprised of three parts:

- **Part 1: Regional Program Elements** is the basic framework for the Regional Road Maintenance ESA Program. It includes ten program elements that make up the Regional Program. The program elements combine policy, management, field practices, and science to form a comprehensive approach to conservation of listed species. Implementation of all ten program elements is required for a local agency to obtain a 4(d) take limit[1](NMFS), and/or a reduction or elimination of the prohibition on take of threatened species (USFWS).

- **Part 2: Best Management Practices** is a set of site-specific best management practices (BMPs) for road maintenance. Under the Regional Program, road maintenance, environmental, and engineering design staff can use these BMPs, in addition to routine BMPs presented in Part 1, to achieve conservation outcomes identified in the *Guidelines*. State regulations and local ordinances or site-specific permit conditions may all dictate use of specific BMPs. For that reason, Part 2 offers a menu of possible BMPs from which the most suitable method can be selected.

[1] This BR evaluates the environmental effects of the program elements contained in the Regional Program. This BR does not include those activities outside the scope of the Regional Program. Agencies may decide to request exceptions in their Part 3 application for additional maintenance categories than those covered under the Regional Program. However, agencies that request exceptions to the Regional Program must include a BR of those categories of activities.

- **Part 3: Application** is an individual agency application for a 4(d) take limit (NMFS) special 4(d) rule and/or Section 7 take exemption, to receive an elimination or reduction of the standing prohibition of take for threatened species (USFWS) under the Regional Program. The Part 3 Application, known as the "plug-and-play" part of the Regional Program, allows local agencies to "plug" into Parts 1 and 2 of the Regional Program. **The Part 3 Application is a specific commitment that an agency will comply with the ten program elements in Part 1.**

Only activities that fall under the definition of "maintenance" are covered under this Regional Program. Below is the definition of the term "maintenance":

Maintenance: Repair and maintenance include activities that:

(a) Are conducted on currently serviceable structures, facilities, and equipment; and

(b) Involve no expansion of or change in use of such structures, facilities, and equipment beyond those that existed previously; and

(c) Do not result in significant negative hydrological impact.

Repair and maintenance includes those usual activities taken to prevent a decline, lapse, or cessation in the use of structures and systems or to replace dysfunctional facilities. Repair and maintenance also includes replacing existing structures with different types of structures, PROVIDED THAT replacement is required to meet current engineering standards or by one or more environmental permits, and the functioning characteristics of the original structure are not changed. An example would be replacing a collapsed, fish blocking, round or wooden culvert with a new box culvert under the same span, or width of roadway.

This program does not apply to the following:

- construction of new facilities, or major expansion of existing facilities

2.0 Description of Action: The Regional Program

There are 10 program elements in the Regional Program. These 10 elements provide the basic umbrella for the Regional Program. The program elements function as non-discretionary measures that are necessary and appropriate to minimize potential adverse impacts of road maintenance activities on listed species, while continuing to achieve positive habitat benefits. Each local agency will implement a Part 3 Application to achieve conservation outcomes within the framework of these 10 program elements. Each program element, and its contribution to the conservation of listed species, is described below:

2.1 Program Elements

The program elements are fully described in the Regional Road Maintenance ESA Program Guidelines (*Guidelines).*

2.1.1 Element 1 - Regional Forum

A Regional Forum has been created from participating agencies. The Regional Forum provides a regional meeting for program discussion, coordination, and adaptive management. In terms of contributing to conservation, the Regional Forum provides a process whereby, as new information is gathered in each individual agency, it can be shared with other agencies across the State. Sharing information on successful BMP applications in the field, together with scientific research, creates a potential for each agency to improve its contribution to conservation over time. Additionally, if a problem with program implementation occurs in one jurisdiction, this information sharing prevents repeated problems.

2.1.2 Element 2 – Program Review and Approval

The program review and approval process will require that each agency participating in the Regional Program comply with the ten program elements. The Washington State Department of Transportation (WSDOT) Highways and Local Programs (H&LP), Olympia Service Center or the Regional Forum, will review each agency's Part 3 Application to determine whether or not all program elements are included. The goal of the Program Review and Approval process is to establish consistency across Washington so that conservation measures are achieved. **The Services will issue approval for each agency to receive a take limit (NMFS) under Limit 10 (ii) of the 4(d) Rule, and/or a reduction or elimination of the prohibition on take of threatened species (USFWS).**

2.1.3 Element 3 - Training

Courses will include the topics of basic ESA, design, biological review, permit activities, maintenance BMPs, and monitoring BMP activities. The WSDOT Technology Transfer (T2) Center, University of Washington, or WSDOT Operations and Maintenance Program in conjunction with the Regional Forum, will develop a curriculum for training maintenance employees in the implementation of the Regional Program that may be taught by T2 instructors or other trainers. Thorough training on all elements of the Regional Program, at applicable levels of implementing agencies, provides consistency across the State so that conservation goals can be met.

2.1.4 Element 4 – Compliance Monitoring

The objective of compliance monitoring is to evaluate program implementation to accomplish Regional Program conservation goals consistently across the State. Compliance monitoring will take place at several levels: local agency supervisory staff, local agency permitting authorities, and state and federal permitting authorities evaluating BMPs for use and implementation. Each local agency will establish a formal compliance monitoring program for monitoring BMP outcomes and any monitoring that is part of various research projects.

2.1.5 Element 5 – Scientific Research

Case studies in the field, as well as literature research done by others, are included in this program element. The scientific research element will serve to verify effectiveness of BMPs and update BMPs based on the latest technologies. Using information derived from scientific research, conservation opportunities can be maximized.

2.1.6 Element 6 – Adaptive Management

The adaptive management philosophy will apply to all ten elements of the Regional Program. The training, research, biological data collection, and program monitoring elements are the basis for adaptive management. Adaptive management provides a means by which potential adverse impacts are avoided and minimized, and conservation opportunities maximized, as the Regional Program is implemented throughout the State of Washington.

2.1.7 Element 7 – Emergency Response

This element provides a framework under which road maintenance organizations can operate during emergencies. This program element allows for necessary emergency response measures, while keeping the Services and regulatory agencies apprised.

2.1.8 Element 8 – Biological Data Collection

This element includes habitat location information within the ROW and development of a process to train and alert staff where the *Guidelines* need to be applied.

2.1.9 Element 9 – Biennial Reports

The Regional Forum will provide biennial (every 2 years) reports to the Services. Biennial Reports will include a review of the ten program elements, updates on research, recommended BMP changes, and recommended updates on each program element.

2.1.10 Element 10 – Best Management Practices (BMPs) and Conservation Outcomes

Under the Regional Program, BMPs and desired conservation outcomes have been developed for road maintenance activities. The Regional Forum will annually review and update the BMPs. Local agencies and the Services will review the changes the Regional Forum recommends for adoption.

2.2 Maintenance and Repair Activities

This program does **not** apply to construction of new facilities or major expansion of existing facilities. The Regional Program is not intended to include development or redevelopment activities. Instead, the Regional Program encompasses road maintenance work performed on the existing right-of-way (ROW) structure. This section defines the scope of maintenance work.

2.2.1 Maintenance Definition

As stated in the Introduction, only activities that fall under the following definition of "maintenance" are covered under this Regional Program:

> **Maintenance:** Repair and maintenance include activities that:
>
> (a) Are conducted on currently serviceable structures, facilities, and equipment; and
>
> (b) Involve no expansion of or change in use of such structures, facilities, and equipment beyond those that existed previously; and
>
> (c) Do not result in significant negative hydrological impact.

Repair and maintenance includes those usual activities taken to prevent a decline, lapse, or cessation in the use of structures and systems or to replace dysfunctional facilities. Repair and maintenance also includes replacing existing structures with different types of structures, PROVIDED THAT replacement is required to meet current engineering standards or by one or more environmental permits, and the functioning characteristics of the original structure are not changed. An example would be replacing a collapsed, fish blocking, round or wooden culvert with a new box culvert under the same span, or width of roadway.

2.2.2 Right-of-Way Structure

This section describes the ROW structure, and how maintenance activities contribute to habitat conservation. A detailed analysis is presented, evaluating road maintenance impacts before Regional Program implementation compared with impacts after the Regional Program is implemented.

Road maintenance activities occur within the ROW. The ROW is the area of land dedicated for public use or secured by the public for purposes of ingress and egress to abutting property and other public purposes. ROW includes areas maintained by public agencies through prescriptive rights. ROW structures include planned, designed, engineered and constructed features that together encompass many built systems. Typical ROW structures include, but are not limited to, the following:

- Open drainage system/sediment transport system
- Closed drainage system/sediment transport system
- Retention/detention/wetland systems/sediment transport system
- Road surface/drainage and sediment transport system
- Utilities
- Stream system
- ROW itself, width, air space above and underground.

An understanding of the ROW, its structures, and its relationship to water quality and habitat is critical to the successful implementation of the Regional Program, and to the evaluation of the program in terms of contribution to conservation.

Examples of system structures within the ROW include but are not limited to the following: roadway, drainage, sediment containment, retention/detention, water, sewer, gas, electrical, street lighting, traffic loops, and traffic signals vegetation management, and the ROW itself.

The aboveground surface area of the ROW structure consists of, but is not limited to, the roadway shoulder(s), cuts, fills, ditches, channels, dikes, bridges, retention/detention structures, swales and constructed wetlands (intentional and incidental). The road surface directs water from the road, across the gravel or grass shoulder, across the in slope of the ditch, through the ditch to a swale or retention/detention area and then to an outlet.

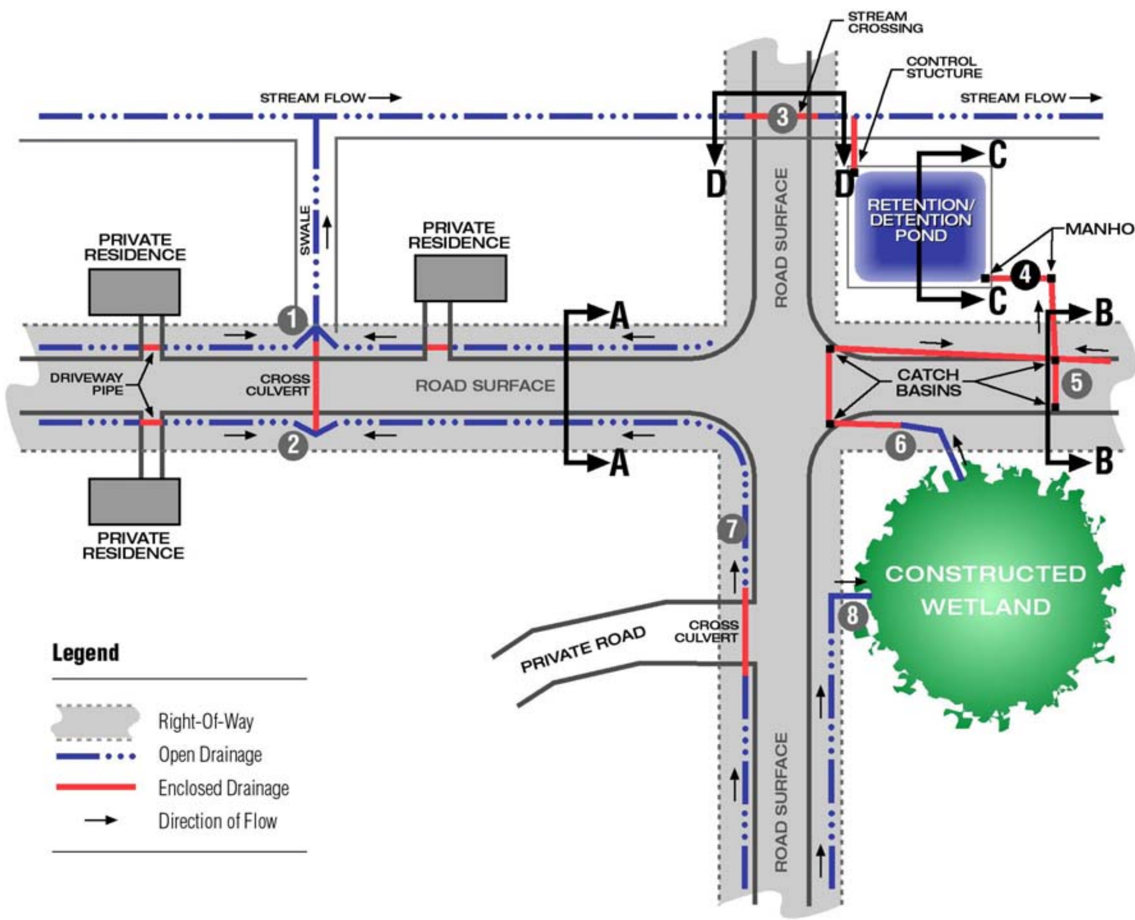
The ROW structure also includes a sediment transport (storm water) system. The function of this system is to remove sediment before it outfalls to a watercourse or stream. The roadway drainage system has built-in storm water retention capacity. The road surface traps large amounts of fine material, where it can be removed by sweeping operations, thereby preventing sedimentation in watercourses or streams. Gravel or grass shoulders filter and trap sediments. Ditches hold and trap sediments frequently acting as long, narrow retention/detention ponds. Storm water retention/detention facilities and constructed wetlands hold and trap large amounts of sediment, reducing downstream sedimentation. The open drainage system is designed to trap sediments. Road maintenance removes these sediments before they pass through the system to a stream or watercourse.

Like an open drainage system, an enclosed drainage system transports sediment to built-in trapping and holding areas where the sediment can be removed before it reaches a stream or watercourse. An enclosed drainage system starts with the road surface or structure and directs water and sediment to inlets, catch basins, manholes, vaults, pipes, and retention/detention facilities. Inlets to the enclosed drainage system both limit the size of sediments and hold sediments. Catch basins, manholes, vaults, pipes, and retention/detention/constructed wetland facilities trap large quantities of sediments so they can be removed before they enter the outflow.

Road and utility maintenance activities occur within the road ROW structure. Figures 1-5 show typical cross-sections of the ROW structure, including the following:

- Figure 1: Typical ROW Structure
- Figure 2: Section A-A: Open Drainage System
- Figure 3: Section B-B: Enclosed Drainage System
- Figure 4: Section C-C: Retention/Detention Facility
- Figure 5: Section D-D: Stream Crossing Road.

Figure 1 Typical Row Structure



Legend

- Right-Of-Way
- Open Drainage
- Enclosed Drainage
- Direction of Flow

Probable BMP Locations

1. Where water leaves the ROW
2. Prior to water crossing the roadway
3. Upstream and downstream of stream crossing
4. Prior to water entering the detention facility
5. Cleaning of structures and oil water separators
6. Prior to water entering the enclosed system
7. Along ditches to collect siltation
8. Wherever water leaves ROW into sensitive areas

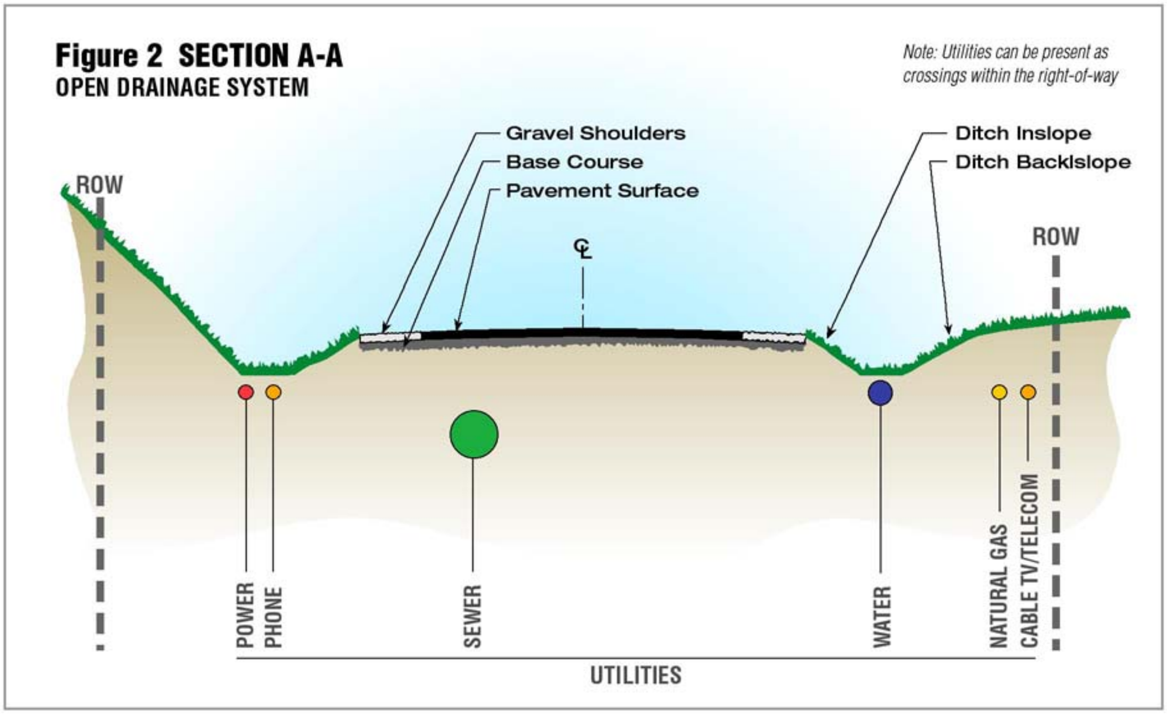


Figure 2 SECTION A-A
OPEN DRAINAGE SYSTEM
Note: Utilities can be present as crossings within the right-of-way
Gravel Shoulders
Base Course
Pavement Surface
Ditch Inslope
Ditch Backslope
ROW
ROW
POWER
PHONE
SEWER
WATER
NATURAL GAS
CABLE TV/TELECOM
UTILITIES

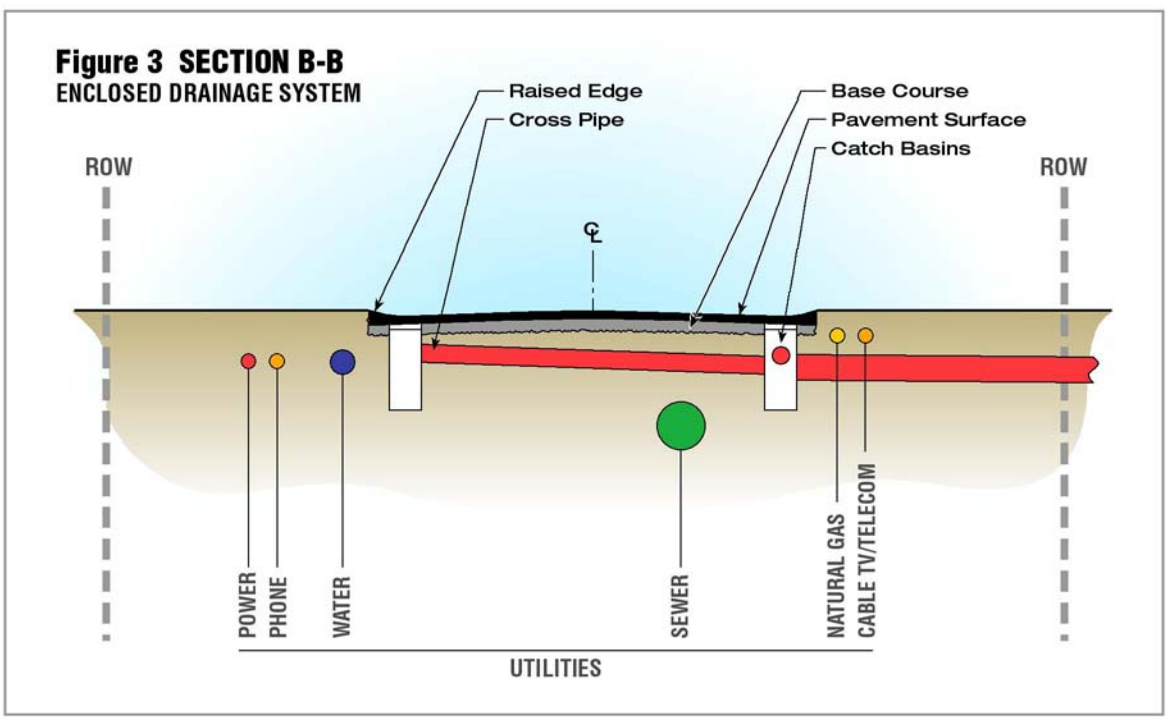


Figure 3 SECTION B-B
ENCLOSED DRAINAGE SYSTEM
Raised Edge
Cross Pipe
Base Course
Pavement Surface
Catch Basins
ROW
ROW
POWER
PHONE
WATER
SEWER
NATURAL GAS
CABLE TV/TELECOM
UTILITIES

Figure 4 SECTION C-C
RETENTION/DETENTION FACILITY

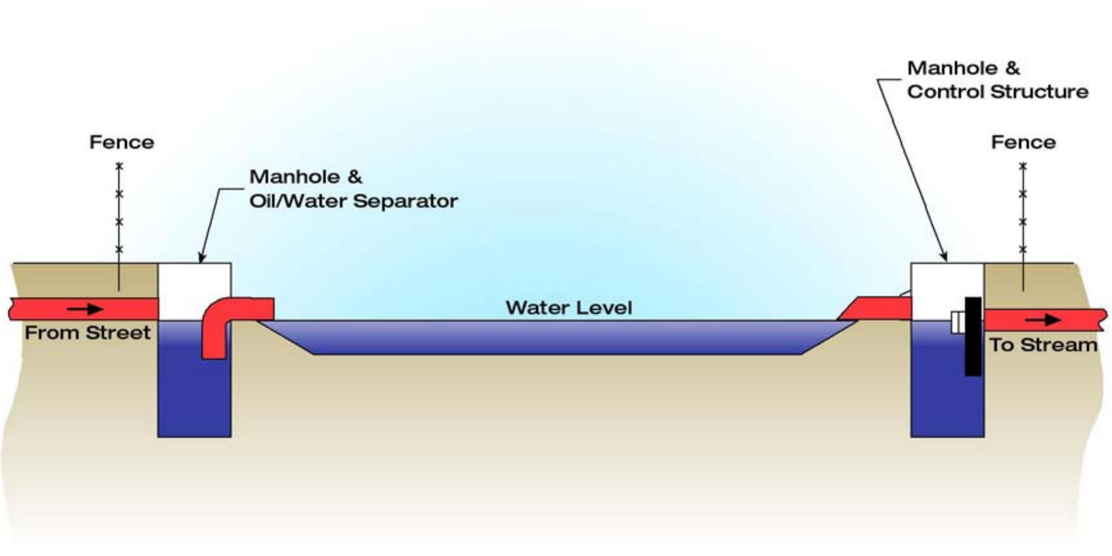
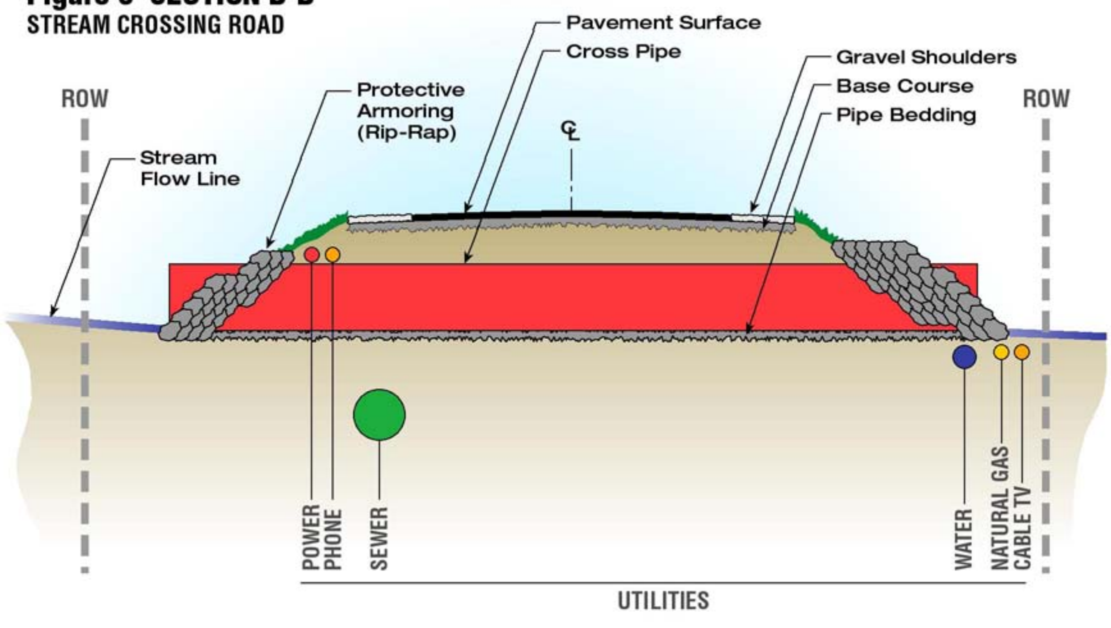


Figure 5 SECTION D-D
STREAM CROSSING ROAD



2.2.3 Maintenance Categories

Following are the Maintenance Categories as defined in the *Guidelines.* Within each category are descriptions of the road maintenance activities most commonly performed.

2.2.3.1 Category 1 - Roadway Surface

The roadway surface is part of the Right-of-Way (ROW) structure. The slope of the roadway surface routes water and sediments off the roadway to the shoulder, to an open drainage area or ditch, or enclosed drainage system. Thus, the slope of the roadway surface is part of the water flow and sediment collection systems. The purpose of repair, replace, install, or maintain roadway surfaces include:

- Pothole and square cut patching
- Removing paved surfaces or roadway base
- Repairing roadway base
- Repaving
- Adding gravel or grading surfaces
- Dust control
- Extending pavement edge
- Paving graveled shoulder
- Crack sealing and overlay
- Chip seal
- Resurfacing
- Pavement marking and traffic channelization
- Traffic control features.

BMPs proposed for maintaining, repairing, installing, or replacing roadway surfaces are designed to achieve one or more of the following habitat goals:

- Protect watercourse, stream and/or water body
- Maximize opportunities for increased infiltration
- Reduce runoff (of dirt, debris, sediment, and petroleum products) from maintenance activity to contribute to restoration of water quality.

2.2.3.2 Categories 2 and 3 - Enclosed Drainage Systems and Cleaning of Enclosed Drainage Systems

The enclosed drainage system is part of the ROW structure that routes water and sediments from roadways and surface structures through water and sediment collection systems to outlet areas. Facilities can be located within the ROW, public property, separate tracts, easements, or on private property. Enclosed drainage systems, which are used for water quality and quantity treatment, are designed to accumulate sediments over time. Because of limited storage capacity, this sediment should be removed to maintain treatment effectiveness and environmental protection. The purpose of repair, replacement, installation, cleaning and maintenance tasks on enclosed drainage systems includes the following:

- Removing large quantities of sediment and debris from storm water before it enters watercourses or streams
- Ensuring the roadway drainage system removes, collects and conveys water from the ROW to permit the maximum use of the roadway
- Reducing damage to roadway structures
- Protecting abutting property from damage
- Restoring surface water drainage
- Ensuring structural integrity
- Vegetation management

BMPs proposed for maintaining, repairing, installing and replacing enclosed drainage systems are designed to achieve one or more of the following habitat goals:

- Protect watercourse, stream and/or water body
- Reduce worksite pollutants run off to restore or maintain water quality
- Control storage, delivery, and routing of surface and ground water to control volumes and velocities of storm water discharge by cleaning and maintaining system
- Reduce pollutant transport from system breaks by performing repairs.

2.2.3.3 Category 4 - Open Drainage Systems

Like the enclosed system, the open drainage system is part of the ROW structure that routes water and sediments from roadways and surface structures through water and sediment collection systems to outlet areas. Facilities can be located within the ROW, public property, separate tracts, easements, or on private property. Open drainage systems include storm water conveyance systems that were created entirely by artificial means, such as roadside ditches and storm or surface water run-off facilities. These structures are not watercourses, streams or wetlands. Maintenance tasks may involve the following activities:

- Cleaning
- Reshaping/re-grading
- Erosion control/bank stabilization of drainage system
- Vegetation management
- Removal of debris, trash, yard waste and sediment
- Repair of structures.

These tasks are performed on facilities, retention/detention facilities, swales, pollution control devices, manholes, catch basins, vaults, pipes, culverts, inlets/outlets, and ditches.

The open drainage system allows sediment to separate and settle from the water flow, thus cleaning and removing large quantities of sediment out of the storm water system. Maintenance operations are performed when sediment, debris, or vegetation in a ditch impedes flows or storage of water and sediments to a point where safety or structural integrity of the roadway system is jeopardized.

BMPs proposed for maintaining, repairing, and cleaning open drainage systems are designed to achieve one or more of the following habitat goals:

- Protect downgrade habitat by removing sediment
- Protect water quality
- Reduce worksite pollutant runoff to watercourses, streams and/or water bodies
- Maintain or restore the storage, delivery, and routing of surface and ground water
- Control volumes and velocities of discharge by removing sediment loading from drainage systems
- Maintain or restore the storage area of sediment and other pollutants
- Remove sediment from system
- Vegetation management

2.2.3.4 Category 5 - Watercourses and Streams

Watercourses, rivers and/or streams refers to any portion of a channel, bed, bank, or bottom waterward of the ordinary high water line of the waters of the State. This definition includes areas in which fish may spawn, reside, or through which they may pass, and tributary waters with defined bed or banks, which influence the quality of fish habitat downstream. This definition includes watercourses that flow on an intermittent basis or that fluctuate in level during the year and applies to the entire bed of the watercourse whether or not the water is at peak level. This definition does **not** include irrigation ditches, canals, storm water runoff devices, or other entirely artificial watercourses, except where they exist in a natural watercourse that has been altered by humans.

Some roadside ditches and/or storm water facilities can be watercourses or streams. Proposed maintenance activities within waters of the State will be reviewed prior to work with the Washington State Department of Fish and Wildlife (WDFW) staff to achieve Hydraulic Project Approval (HPA) compliance.

Maintenance tasks for watercourses, rivers and/or streams involve the following activities:

- Structural repair/replacement
- Slope stabilization
- Sediment removal
- Vegetation management
- Debris removal
- Habitat maintenance/improvements, such as, fish ladders, weirs, and LWM.
- Access road maintenance

BMPs proposed for the maintenance of watercourses and streams are designed to achieve one or more of the following habitat goals:

- Protect habitat
- Protect water quality
- Reduce worksite pollutant runoff to watercourses, streams and/or water bodies

- Maintain or restore the storage, delivery, and routing of surface and ground water to control volumes and velocities of discharge by removing sediment loading from drainage system
- Remove sediment from system
- Identify the number of chronic sediment deposit problem sites that require frequent sediment removal.

2.2.3.5 Category 6 - Stream Crossings

The repair, maintenance, cleaning, installation, replacement or upgrade of pipes, arch pipes, box culverts, fish ladders, weirs, sediment pools, access roads, and bridges are conducted to prevent flooding or catastrophic road failure. Flooding and road failures can occur from structures filled to capacity, blocked with sediment or debris, damaged or may be undersized. Maintenance within waters of the state will require HPA compliance.

BMPs proposed for maintaining stream crossings are designed to achieve one or more of the following habitat goals:

- Repair, replace, or maintain structure
- Protect habitat and watercourse or stream by, or while, performing maintenance
- Reduce worksite pollutant runoff
- Restore or maintain fish passage through structure
- Maintain or restore the storage, delivery, and routing of surface and ground water to control volumes and velocities of discharge by maintaining structure
- Reduce flooding.

In some cases, habitat restoration work is possible as part of a road maintenance activity. In many cases, this type of work is beyond the scope of routine maintenance activities, but might be done as a capital improvement project or a major restoration project. Whether done on a small scale as part of a maintenance activity, or on a more significant level as a capital improvement project, the following BMPs may apply where ROW is available and to the extent that design/habitat considerations allow:

- Remove artificial bank hardening and/or channel confining structures
- Enhance or add areas for spawning, migration, feeding or rearing habitat
- Create connections to off-channel habitat.

2.2.3.6 Category 7 - Gravel Shoulders

Maintenance activities on gravel shoulders are performed to ensure the shoulder functions as a filter for sediment, provides bio-filtration, and controls surface water runoff. Maintenance activities include removal of sediment, sod and debris from the shoulder, restore filtering ability; restore proper grade; improve drainage; vegetation control to maintain adequate site distances; and smoothing ruts.

BMPs proposed for maintaining gravel shoulders are designed to achieve one or more of the following habitat goals:

- Protect watercourse, streams, and other water bodies
- Restore or maintain water quality
- Control storage, delivery, and routing of surface and ground water
- Control volumes and velocities of storm water discharge by cleaning and maintaining shoulders, which allows for sheet flow and infiltration
- Reduce sediment transport by removing sediments before they enter watercourses and/or streams
- Maximize opportunities for increased infiltration and/or bio-filtration.

2.2.3.7 Category 8 - Street Surface Cleaning

Street surface cleaning activities are performed to provide a safe roadway surface. Sweeping reduces sediment loading of the drainage system, surface waters, watercourses, streams, and other water bodies. Water spray systems are used on sweepers to reduce dust. Pickup sweepers remove materials from the roadway.

BMPs proposed for street surface cleaning are designed to achieve one or more of the following habitat goals:

- Restore or preserve water quality
- Protect watercourses, streams and/or other water bodies by performing maintenance
- Reduce sediment transport and loading of drainage systems, watercourses or streams, or other water bodies
- Reduce sediment and pollutant transport and loading of drainage systems, watercourses, streams or other water bodies.

2.2.3.8 Category 9 - Bridge Maintenance

Bridge repair, replacement, installation and maintenance activities are performed to provide a safe roadway and to protect bridge infrastructure according to local, state and federal regulations. Maintenance activities include inspecting, testing, repairing, replacing, maintaining, painting, or resurfacing various components of the bridge. WDFW reviews and permits activities requiring an HPA prior to work activities.

BMPs proposed for bridge maintenance are designed to achieve one or more of the following habitat goals:

- Contribute to the restoration and/or enhancement of aquatic habitat (HPA)
- Control worksite pollutant runoff
- Maintain or restore fish passage through structure
- Maintain or restore water quality off bridge by maintaining drainage system
- Repair, replace or maintain structure
- Maintain habitat and water course or stream by performing maintenance
- Reduce flooding

- Preserve or restore watercourse or stream velocities impaired by blockages in the vicinity of bridge maintenance activity.

2.2.3.9 Category 10 - Snow and Ice Control

Snow and ice control activities are performed to provide a reasonably safe roadway surface. Sanding and plowing operations are considered to be work of such importance that they are classified as emergency operations and take precedence over all non-emergency work. **Post-event cleanup is considered a continuation of the activity.**

BMPs proposed for snow and ice control are designed to achieve one or more of the following habitat goals: maintain or restore water quality and protect aquatic habitat and riparian area.

2.2.3.10 Category 11 - Emergency Slide/Washout Repair

Slides and washouts are caused by the impact of heavy rainfall or freeze and thaw conditions on unstable and/or saturated soils. Slides and washouts may occur on the slope above or below roadways, private property, or sensitive areas. Slide or washout repair activities may include the following:

- Removal of slide/washout material from the ROW
- Backfilling or stabilizing slope
- Reestablishment of damaged roadway features
- Repairing and cleaning the drainage system
- Restoring access roads
- Re-vegetation
- Armoring with rock.

The initial response to emergencies relating to slide and washout repair is covered under Program Element 7, Emergency Response. After the emergency is stabilized, the repair work is covered under this maintenance category.

BMPs proposed for emergency slide/washout repairs are designed to achieve one or more of the following habitat goals:

- Reduce erosion/sedimentation to restore water quality
- Reduce sedimentation loading off-site
- Contribute to the restoration of aquatic habitat (HPA)
- Encourage re-vegetation to stabilize slope and provide riparian habitat near aquatic habitat
- Maintain or restore the storage, delivery, and routing of surface and ground water by restoring the damaged structure.

2.2.3.11 Category 12 - Concrete Surfaces

The removal and repair of damaged concrete roadways, sidewalks, driveways, and curb and gutter sections are performed to provide a safe roadway and pedestrian traffic infrastructure and to maintain adequate conveyance of surface water to drainage systems. Maintenance activities may also involve the installation of new concrete structures.

BMPs proposed for concrete maintenance activities are designed to achieve the following habitat goal:

- Reduce pollutant runoff to restore water quality.
- Reduce velocities and allowing sheet flow when possible.
- Reduce worksite runoff to watercourses, streams and/or water bodies
- Maintain or restore the storage, delivery, and routing of surface and ground water
- Maintain or restore the storage area of sediments and other pollutants
- Remove sediment from system
- Protect water quality

2.2.3.12 Category 13 - Sewer Systems

Sewer and storm systems are designed to efficiently collect and remove water from the ROW to permit the maximum use of the roadway, prevent damage to roadway structures, protect abutting property from damages, and restore surface water drainage in combined sewer/storm systems and manage vegetation. To maintain integrity of infrastructure and operational reliability the following systems are repaired, replaced, installed and maintained: treatment facilities; lift stations; pump stations; main lines; collection lines; trunk lines; interceptors; lake lines, access roads, associated ROWs and storage/detention facilities.

BMPs proposed for sewer system maintenance activities are designed to achieve one or more of the following habitat goals:

- Protect watercourses and/or streams
- Reduce worksite pollutants to restore or maintain water quality
- Control the storage, delivery, and routing of surface and ground water to control volumes and velocities of storm water discharge by repairing and maintaining sewer system
- Repairs reduce sediment transport from system breaks
- Maximize opportunities for increased infiltration or infiltration.

2.2.3.13 Category 14 - Water Systems

Water system maintenance is conducted to maintain the integrity of the infrastructure, collect, treat and distribute clean drinking water, provide additional service and components, maintain operational reliability, and protect health and safety issues. Maintenance activities are performed on the operating components of the water system facilities including but not limited to treatment plants, transmission mains, distribution lines, fire flow systems, reservoirs, tunnels and pump stations, meters, flushing, dewatering, services and associated ROWs or access roads.

BMPs proposed for water system maintenance activities are designed to achieve one or more of the following habitat goals:

- Protect watercourses and/or streams

- Reduce worksite pollutants to restore or maintain water quality
- Control the storage, delivery, and routing of surface and ground water to control volumes and velocities of storm water discharge by restoring surface after installation, repair or replacement of underground piping
- System maintenance and repairs reduce sediment transport from system breaks
- Maximize opportunities for increased infiltration or bio-filtration where possible.

2.2.3.14 Category 15 - Vegetation

Vegetation is part of the ROW structure. Vegetation maintenance will be conducted in all roadway categories including roadway surface, open and closed drainage, sediment containment, water courses and streams, stream crossings, shoulders, and utilities. The purpose of vegetation maintenance is to promote, maintain, sustain, manage, or encourage vegetation growth within the ROW to comply with a variety of regulations and standards including public safety. Vegetation maintenance improves visibility, surface and subsurface drainage, fire and pollution control, and clear zone area.

BMPs proposed for maintaining vegetation are designed to achieve one or more of the following habitat goals:

- Improve drainage by reducing erosion
- Reduce the spread of noxious weeds and undesirable vegetation
- Limit erosion
- Increase bio-filtration
- Lower herbicide use
- Provide shading/reduce water temperature
- Provide habitat for macro invertebrates
- Provide LWM

2.3 Local Government 4(d) Applications

Each agency desiring a take limit under the 4(d) Rule (NMFS), and/or a reduction or elimination of the prohibition on take of threatened species (USFWS) for its routine road maintenance activities prepares a Part 3 Application. The Part 3 Application is the “plug-and-play” element of the Regional Program and allows an agency to “plug” into the Services-approved Parts 1 and 2 of the Regional Program. The Part 3 Application is a commitment that an agency will implement Parts 1 and 2.

Agencies that fully implement the Regional Program with no significant exceptions, additions, or alterations will not be required to prepare an agency-specific biological review. A Federal Register notice will be published by the Services, announcing that the agency intends to implement the Regional Program, as it has been approved. Any deviations from the Regional Program, however, will be evaluated by the Services, which will determine whether or not the deviation is significant enough to require a separate, agency-specific, biological review. If an agency-specific biological review is required, the Services will have to evaluate the program deviations, together with the agency-specific biological review to determine if the program is eligible for a take limit under the 4(d) Rule (NMFS), and/or a reduction or elimination of the prohibition on take of threatened species (USFWS). A separate Federal Register publication and public comment period will also be required in these cases. Included in the notice will be the deviations from the Regional Program, and the biological review supporting the proposed program.

The Part 3 Application contains the following sections:

- **Section 1 – Letter of Commitment**: This section is a letter of commitment requesting the services to approve plug and play for the agency to use Parts 1 and 2 of the Regional Program to receive a take limit under the 4(d) Rule (NMFS), and/or a reduction or elimination of the prohibition on take of threatened species (USFWS).
- **Section 2 – Compliance with Parts 1 & 2**: This section contains the ten Program Elements in the Regional Program. Those agencies commit to complying with each program element at both the regional level and local level.
- **Section 3 – General Procedures**: This section contains the general procedures of an agency. It outlines organizational structure, maintenance selection process, selecting/implementing the BMPs, checklist process, and adaptive management.
- **Section 4 - Exceptions**: This section contains any exceptions from the Regional Program. It highlights any agency programs that are not included in the Regional Program, any deviations, any additional maintenance categories not listed in Part 1, checklist processes (if they differ from those in the Regional Program) or any additions or changes outside of the Regional Program. The Services must evaluate **any program exceptions contained in Section 4 of the Part 3 Application to determine if a separate, agency-specific biological review, and subsequent Federal Register publication and comment period are required.**

The Regional Forum has developed a Program Review and Approval Subcommittee to help agencies through the Part 3 Application process. Agencies can contact the Regional Forum to review the Regional Program and understand it before starting the Part 3 process. (Training for the Regional Program includes this review.)

The Review and Approval Subcommittee can help an agency develop their Part 3 Application by reviewing, answering questions, and helping to understand the Part 3 framework. When completed, the Part 3 Application can be submitted to the Regional Forum for their review before it is submitted to WSDOT H&LP's review process.

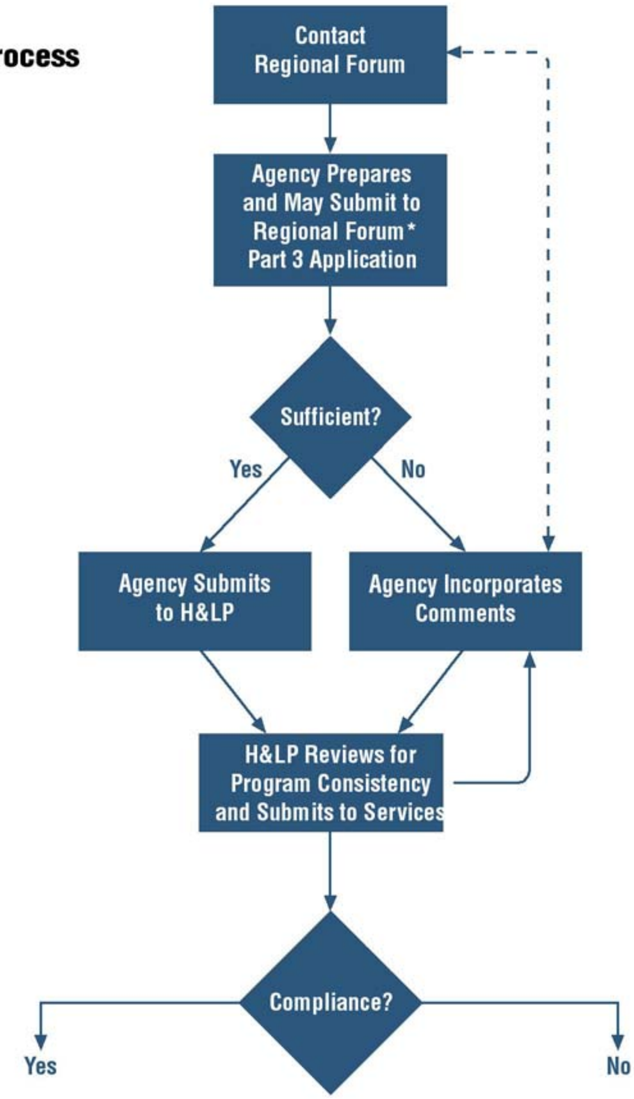
H&LP or the Regional Forum will review the written application for compliance with the Regional Program. If H&LP or the Regional Forum concludes that the Part 3 Application is complete and in compliance with the Regional Program, the application will be forwarded to the Services for final approval of the Part 3 Application. H&LP will provide a written statement that the agency's application is in compliance.

There is a dispute resolution for applications that are incomplete or inconsistent with the framework for Part 3. H&LP will return the application to the agency with a letter of deficiencies for correction. The agency may elect to pass the application on to the Services. However, the letter of deficiencies must be included for the Services review and approval.

The Services will determine final approval of the application for a take limit under the 4(d) Rule (NMFS), and/or a reduction or elimination of the prohibition on take of threatened species (USFWS). The Regional Forum and H&LP reviews are advisory only. The final approval authority for an individual agency resides with the executive and legislative branches of participating local governments.

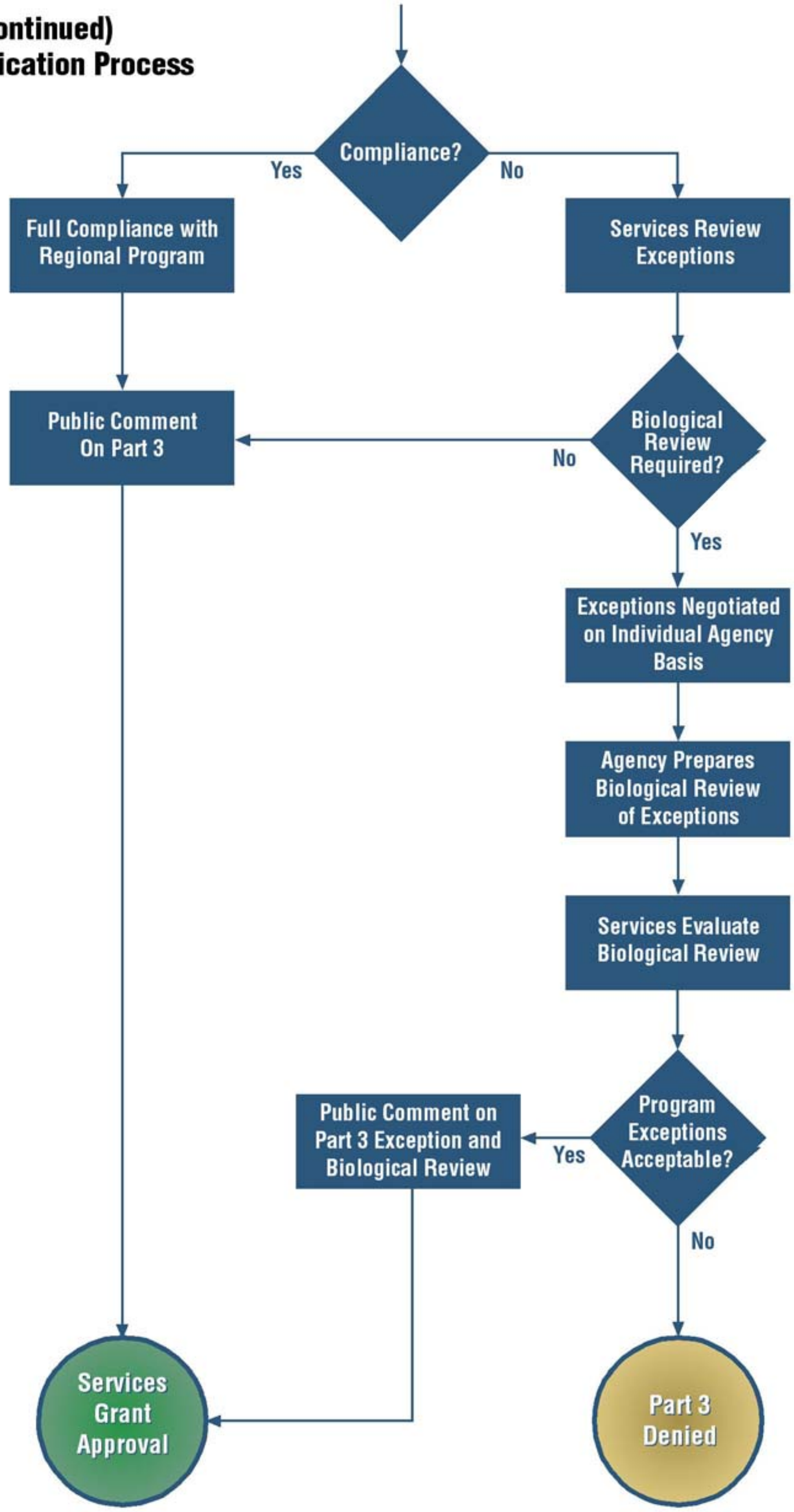
Figure 6 shows the steps that an agency will need to follow to submit their Part 3 Application under the Regional Program. As an agency prepares its Part 3 Application, the agency may seek advice and assistance from the Regional Forum. The agency may also submit its Part 3 Application to the Regional Forum for preliminary review. The agency's Part 3 Application will be referred to H&LP to review it for consistency with the Regional Program. If the Part 3 Application complies with the Regional Program, H&LP submits the Part 3 Application to the Services to obtain a take limit under the 4(d) Rule (NMFS), and/or a reduction or elimination of the prohibition on take of threatened species (USFWS). The flowchart below (Figure 6) shows the requirement that exceptions contained in Section 4 of the Part 3 Application will be evaluated by the Services.

Figure 6
Part 3 Application Process



Continued on Next Page

Figure 6 (Continued)
Part 3 Application Process



3.0 Species Information

To evaluate the Regional Program's contribution to conservation, the status of listed species and their habitat needs must be considered. This section contains basic species and habitat information. References for additional information are also provided.

3.1 Status of the Species

Several salmonid species in Evolutionary Significant Units (ESU) throughout Washington State are listed under the ESA. An ESU is a distinct population segment of Pacific salmon and is treated as a species under the ESA. Table 1 shows the listing status and species applicable under the NMFS 4(d) rule and take limit request. It also gives background information on critical habitat, protective regulations, and biological information for the listed species. Each of these listed species is addressed in this BR.

Table 1

Species Status Reference List

Species	Listing Status	4(d) Take Limit Under the Regional Program	Critical Habitat	Protective Regulations	Biological Information, Population Trends
Chinook Salmon (Oncorhynchus tshawytscha)					
Puget Sound Chinook salmon	March 24, 1999, 64 FR 14308, Threatened	4 (d) Take Limit	February 16, 2000, 65 FR 7764	July 10, 2000, 65 FR 42423	Myers *et al* 1998; WDFW 1993
Lower Columbia River Chinook salmon	March 24, 1999, 64 FR 14308 Threatened	4(d) Take Limit	February 16, 2000, 65 FR 7764	July 10, 2000, 65 FR 42423	Myers *et al.*1998; Healey 1991; ODFW and WDFW 1998; WDFW 1993
Upper Columbia River spring Chinook salmon	March 24, 1999, 64 FR 14308 Endangered	Take Limit Not Applicable	February 16, 2000, 65 FR 7764	ESA prohibition on take applies	Myers *et al.*1998; Healey 1991; ODFW and WDFW 1998; WDFW 1993
Upper Willamette River Chinook salmon	March 24, 1999, 64 FR 14308 Threatened	4(d) Take Limit	February 16, 2000, 65 FR 7764	July 10, 2000, 65 FR 42423	Myers *et al.*1998; Healey 1991; ODFW and WDFW 1998
Snake River Chinook salmon (spring/summer)	April 22, 1992, 57 FR 14653 Threatened	4(d) Take Limit	December 28, 1993, 58 FR 68543 and October 25, 1999, 64 FR 57399	April 22, 1992, 57 FR 14653	Matthews and Waples 1991; Healey 1991; ODFW and WDFW 1998
Snake River Chinook salmon (fall)	April 22, 1992, 57 FR 14653 Threatened	4(d) Take Limit	December 28, 1993, 58 FR 68543	July 22, 1992, 57 FR 14653	Waples *et al.* 1991b; Healey 1991; ODFW and WDFW 1998

Species	Listing Status	4(d) Take Limit Under the Regional Program	Critical Habitat	Protective Regulations	Biological Information, Population Trends
Chum Salmon (Oncorhynchus keta)					
Hood Canal Summer-run chum salmon	March 25, 1999, 64 FR 14508,Threatened	4(d) Take Limit	February 16, 2000, 65 FR 7764	July 10, 2000, 65 FR 42423	Johnson *et al.*1997; WDFW 1993
Columbia River chum salmon	March 25, 1999, 64 FR 14508 Threatened	4(d) Take Limit	February 16, 2000, 65 FR 7764	July 10, 2000, 65 FR 42423	Johnson *et al.*1997; Salo 1991; ODFW and WDFW 1998; WDFW 1993
Sockeye Salmon (Oncorhynchus nerka)					
Ozette Lake Sockeye	March 25, 1999, 64 FR 14508, Threatened	4(d) Take Limit	February 16, 2000, 65 FR 7764	July 10, 2000, 65 FR 42423	Gustafson *et al.* 1997; WDFW 1993
Snake River sockeye salmon	November 20, 1991, 56FR 58619 Endangered	Take Limit Not Applicable	December 28, 1993, 58 FR 68543	ESA prohibition on take applies	Waples et al. 1991a; Burgner 1991; ODFW and WDFW 1998
Steelhead (Oncorhynchus mykiss)					
Upper Columbia River steelhead	August 18, 1997, 62 FR 43937 Endangered	Take Limit Not Applicable	February 16, 2000, 65 FR 7764	ESA prohibition on take applies	Busby *et al.* 1995; Busby *et al.* 1996; ODFW and WDFW 1998; WDFW 1993
Middle Columbia River steelhead	March 25, 1999, 64 FR 14517 Threatened	4(d) Take Limit	February 16, 2000, 65 FR 7764	July 10, 2000, 65 FR 42423	Busby *et al.* 1995; Busby *et al.* 1996; ODFW and WDFW 1998; WDFW 1993
Lower Columbia River steelhead	March 19, 1998, 63 FR 13347 Threatened	4(d) Take Limit	February 16, 2000, 65 FR 7764	July 10, 2000, 65 FR 42423	Busby *et al.* 1995; Busby *et al.* 1996; ODFW and WDFW 1998
Upper Willamette River steelhead	March 25, 1999, 64 FR 14517 Threatened	4(d) Take Limit	February 16, 2000, 65 FR 7764	July 10, 2000, 65 FR 42423	Busby *et al.* 1995; Busby *et al.* 1996; ODFW and WDFW 1998
Snake River Basin steelhead	August 18, 1997, 62 FR 43937 Threatened	4(d) Take Limit	February 16, 2000, 65 FR 7764	July 10, 2000, 65 FR 42423	Busby *et al.* 1995; Busby *et al.* 1996; ODFW and WDFW 1998

Species	Listing Status	4(d) Take Limit Under the Regional Program	Critical Habitat	Protective Regulations	Biological Information, Population Trends
		Bull Trout (Salvelinus confluentus)[2]			
Coastal/Puget Sound Bull Trout	November 11, 1999, 64 FR 58909 Threatened	Take Limit Not Applicable - USFWS Jurisdiction	Not Designated	None proposed at this time	Kraemer, Curt 1994. WDFW, Draft publication and WDFW 1998a.
Columbia River Bull Trout	June 10, 1998, 63 FR 31647 Threatened	Take Limit Not Applicable - USFWS Jurisdiction	Not Designated	None proposed at this time	WDFW 1998a
		Coho Salmon (Oncorhynchus kisutch)[3]			
Lower Columbia River/SW Washington Coho	July 25, 1995, 60 FR 38011 Candidate	Take Limit Not Applicable	Not Designated	None proposed at this time	Johnson, Flagg, Maynard, Milner, and Waknitz 1991
Puget Sound/Strait of Georgia Coho	July 25, 1995, 60 FR 38011 Candidate	Take Limit Not Applicable	Not Designated	None proposed at this time	Weitkamp, Wainwright, Bryant, Milner, Teel, Kope, and Waples 1995
		Cutthroat Trout (Oncorhynchus clarki)			
SW Washington /Lower Columbia River Coastal Cutthroat Trout	April 5, 1999, 64 FR 16397 Proposed Threatened	Take Limit Not Applicable - USFWS Jurisdiction	Not Designated	None proposed at this time	Johnson, Ruckelshaus, Grant, Waknitz, Garrett, Bryant, Neely and Hard 1999

The remainder of this chapter describes life biological requirements for each of the species shown in Table 1. The information was taken from the WSDOT Programmatic Biological Assessment for Aquatic Species (WSDOT 2001).

[2]Bull trout and southwestern Washington Lower Columbia River coastal cutthroat trout are under the jurisdiction of USFWS. Although USFWS comments have been incorporated into the Regional Program, there is no special 4(d) rule available at this time to allow for a reduction or elimination from the take prohibition for bull trout and coastal cutthroat trout. Bull trout and coastal cutthroat trout will not be covered under the NMFS 4(d) take limit. Bull trout and coastal cutthroat trout are included in this analysis because of their presence within Washington State, and for future consideration for a reduction or elimination of the USFWS take prohibition.

[3] Coho salmon are listed as candidate species under the jurisdiction of NMFS. Candidate species are not considered "listed" species and will not be covered under the Regional Program at this time. They are included in this Biological Review because of their presence within Washington State.

3.2 Life Histories and Biological Requirements

This section describes the life histories for six salmonid species including specific stocks listed under the ESA in Washington State. For each stock, the narrative describes their location, general condition, and factors for decline. Their lifecycle timing for upstream migration, spawning, intra-gravel development, and juvenile out-migration for various river systems are shown in Tables 2 through 20.

3.2.1 Chinook Salmon *(Oncorhynchus tshawytscha)*

Juvenile History

In North America, Chinook salmon *(Oncorhynchus tshawytscha)* are found in the larger river systems and some smaller coastal river drainages from California to Alaska. Young Chinook emerge from redds in spring and exhibit one of two different juvenile life strategies: ocean-type rearing or stream-type rearing. Ocean-type juveniles generally enter saltwater during their first year of life, usually in the late summer and fall after emergence. Stream-type Chinook, on the other hand, migrate to saltwater during their second or, occasionally, their third year. Evidence exists that supports the biological basis for these juvenile differences as both environmental and genetic (Randall et al. 1987). Migration distance, stream flows/temperatures, and stream vs. estuary productivity appear to be the strongest environmental factors affecting specific emigration timing (Myers et al. 1998).

Ocean-type juveniles generally rear in estuaries. There is a positive correlation between rivers with a large estuary system and the number of ocean-type Chinook juveniles found in the system (Fraser et al. 1982). Estuaries or near shore environments may be used in systems containing smaller streams, unproductive rearing areas, or flow/thermal barriers. Brackish water in these estuaries may also moderate the physiological stresses during the smolting process (Myers et al. 1998).

Stream-type life histories are most commonly associated with early timed runs of adult fish. It has been generally accepted that stream-type juveniles were the progeny of early-run (spring) Chinook, and ocean-type juveniles were the progeny of summer/fall Chinook. Recent smolt-trapping and scale sampling data, however, indicates that stream-type and ocean-type juveniles can come from any of the Chinook races (spring, summer, or fall runs) (Sneva 1999). Cope and Slater (1957) found that 16% of the Chinook returning to the Coleman Hatchery (Sacramento River) as spring-run adults were produced from fall-run parents, and 19% of the returning fall-run adults came from spring-run parents.

Run Timing and Spawning

Ocean and stream-type Chinook salmon are recovered differentially in coastal and mid-ocean fisheries, indicating divergent migratory routes (Healey 1991). Ocean-type Chinook salmon tend to migrate along or near the coast. Stream-type Chinook, however, are found far from the coast in the central North Pacific (Myers et al. 1998). Ocean migration patterns represent an important form of resource partitioning and are significant to the evolutionary success of the species. Chinook spend between two and six years in the saltwater environment before returning to their natal streams.

Chinook salmon runs are designated on the basis of adult migration timing. Early, spring-run Chinook salmon enter freshwater as immature ("bright") fish, migrate far upstream, and spawn in the late summer and early fall (Myers et al. 1998). Fall Chinook, on the other hand, enter the freshwater at an advanced state of maturity, move rapidly to their spawning areas, and spawn within a few days or weeks (Meehan 1991). Summer-run fish exhibit intermediate characteristics of fall and spring Chinook.

Spawning most often occurs in main stem rivers and larger streams where adequate substrate is located. Average fecundity for Chinook females is about 5,000 eggs (range of 2,250 to 7,750). Depending on water temperature, incubation takes between 90 to 150 days with fry emergence occurring in March and April. Chinook are semelparous and invariably die after spawning.

Habitat Requirements

The timing for Chinook to return to their natal streams is based on their race, but spawning usually occurs when water temperatures reach 5.5° to 13.9°C. Because of their large body size, Chinook tend to use deeper water and larger gravel size than other salmon. The female digs the redd in areas with moderate to high velocities (0.30 to 1.09 m/s) and in water approximately one foot deep (Reiser and Bjornn 1979). Spawning areas generally contain clean, cobble-sized substrate (up to 4 inches in diameter), hyporheic flow, and adequate levels of dissolved oxygen. Recommended incubation temperatures range between 5° and 14.4°C (Reiser and Bjornn 1979). Because ocean-type Chinook migrate to sea relatively quickly after emergence from the gravel, rearing habitat in fresh water is of limited concern. However, stream-type Chinook rear in fresh water for a year or more and require certain habitat characteristics. They prefer to remain in the main stem rivers and streams. They generally seek out cover in pools, large substrate, LWM, and undercut banks; off-channel ponds are not typically used for over-wintering (Everest and Chapman 1972).

3.2.1.1 Puget Sound Chinook Salmon

Chinook salmon were proposed as threatened for Puget Sound drainages on February 26, 1998; the official listing took place on March 24, 1999, and covers the Puget Sound region.

Distribution and Condition

This ESU encompasses all runs of Chinook salmon in the Puget Sound region from the North Fork Nooksack River to the Elwha River on the Olympic Peninsula. Most Chinook salmon in this area exhibit an ocean-type life history. Exceptions do occur, however; the Skagit, Nooksack, Snoqualmie, and Snohomish River basins support a combination of ocean- and stream-type juveniles (Sneva 1999). The proportion between juvenile types varies substantially from year to year and appears to be environmentally mediated rather than genetically determined. Puget Sound stocks generally mature at three to four years of age and exhibit similar, coastal oriented, ocean migration patterns. Lifecycle timing is shown in *Table 2*.

The Puget Sound population segment of Chinook covers, either in part or wholly, 15 counties (Clallam, Grays Harbor, Island, Jefferson, King, Kitsap, Kittitas, Lewis, Mason, Pierce, San Juan, Skagit, Snohomish, Thurston, and Whatcom). The 1992 Salmon and Steelhead Stock Inventory (SASSI) indicates that 4 of the 28 Chinook stocks within the Puget Sound ESU are classified as critical, 7 are depressed, 10 are healthy, and 7 are considered unknown due to insufficient data (WDFW et. al.1993).

Table 2a Lifecycle Timing of Puget Sound Chinook

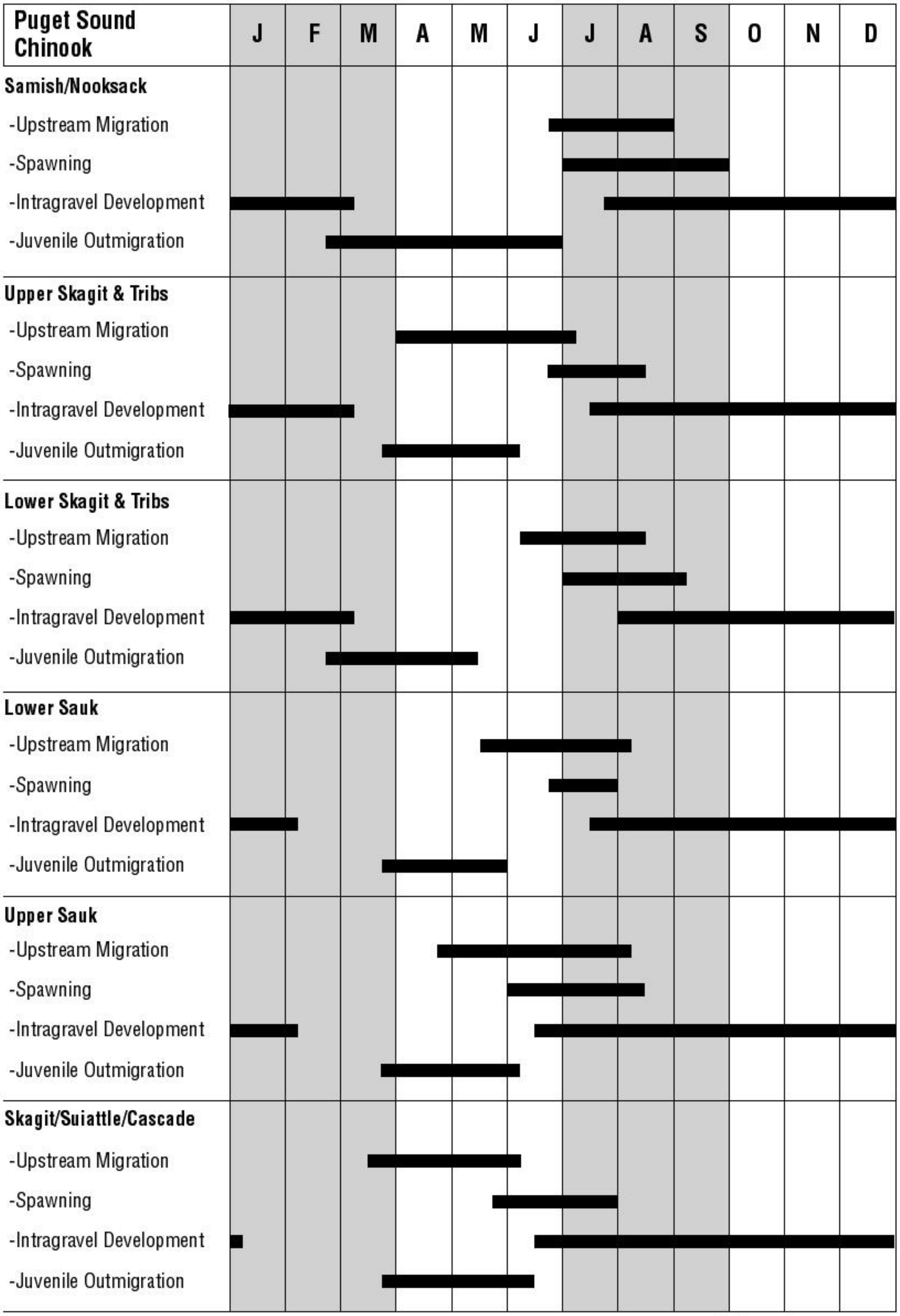


Table continues on next page

Table 2b Lifecycle Timing of Puget Sound Chinook (Continued)

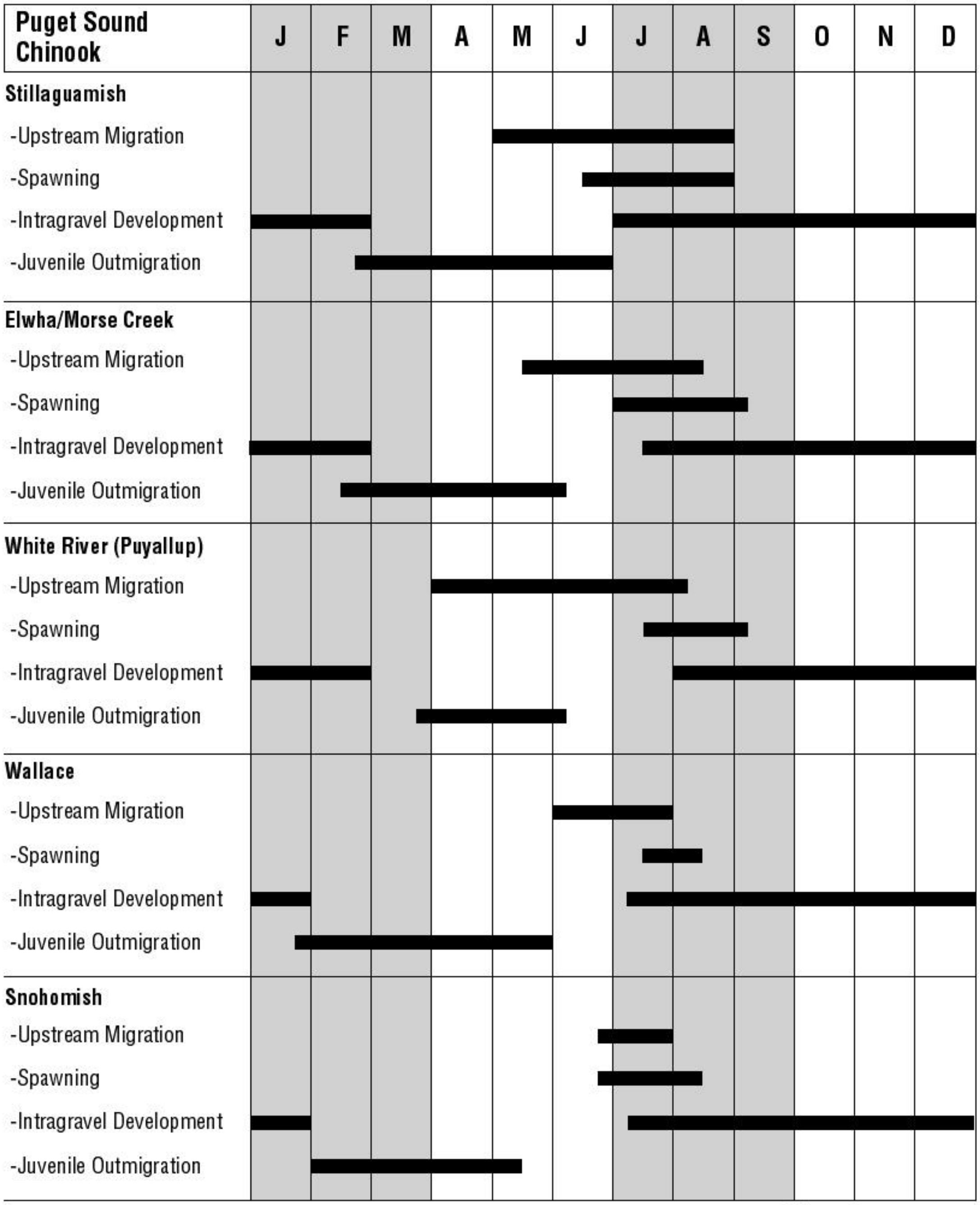
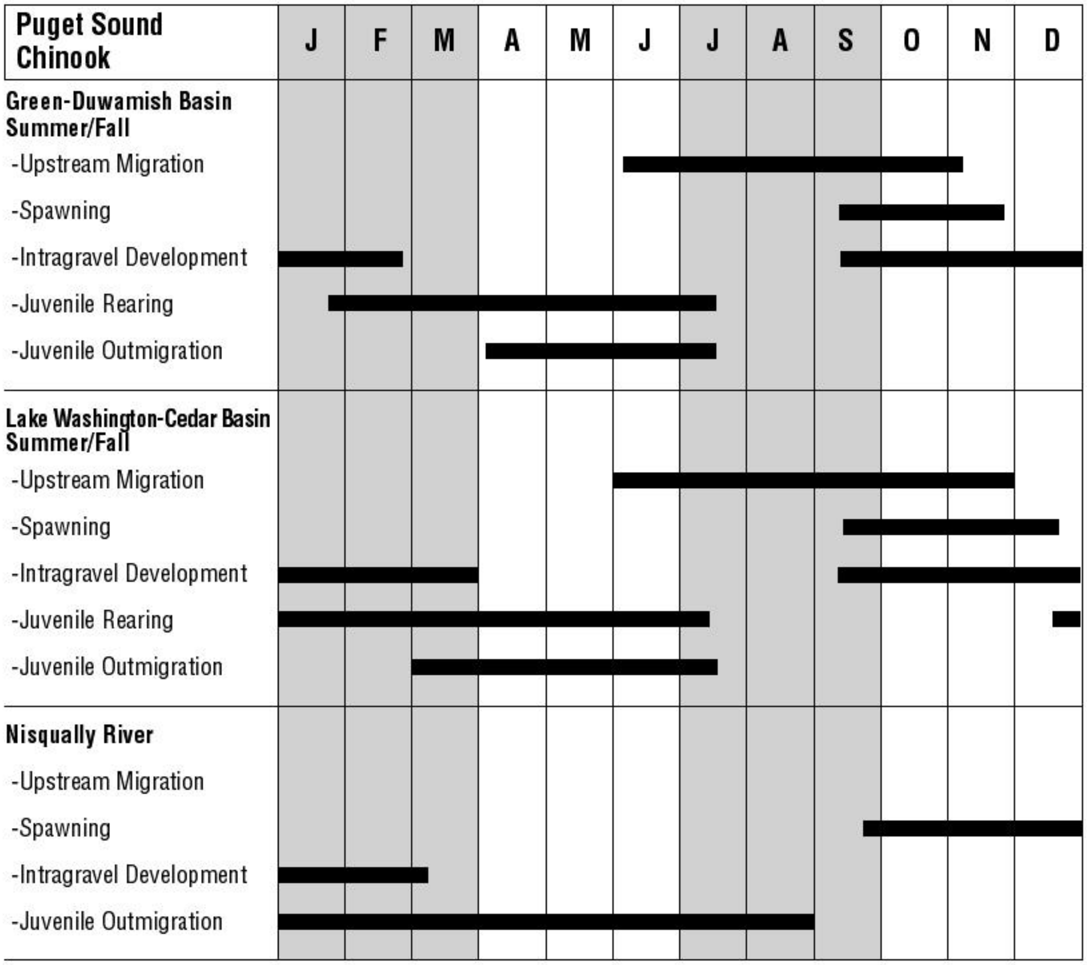


Table continues on next page

Table 2c Lifecycle Timing of Puget Sound Chinook (Continued)



Factors for Decline

With adult and juvenile Chinook presence concentrated in larger rivers and streams, the species has suffered more than any salmon species from the construction of dams and diversions. In the Puget Sound ESU, habitat degradation is another major threat to the existence of Chinook. Historic spawning grounds have been altered or destroyed by urbanization. In stream structure and complexity, necessary for juvenile rearing habitat, has been reduced. Hatchery practices may also contribute to the decline of wild salmon by increasing juvenile competition and diluting the genetic makeup of native Chinook (Meehan 1991).

Critical Habitat

On February 16, 2000 critical habitat was designated to include all marine, estuarine and river reaches accessible to listed Chinook salmon in Puget Sound. Puget Sound marine areas include the south Sound, Hood Canal, and north Sound to the international boundary at the outer extent of the Strait of Georgia, Haro Strait and the Strait of Juan De Fuca to a straight line extending north from the west end of Freshwater Bay, inclusive. Also included are adjacent riparian zones. Excluded are Indian lands and areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 13,761 square miles in Washington.

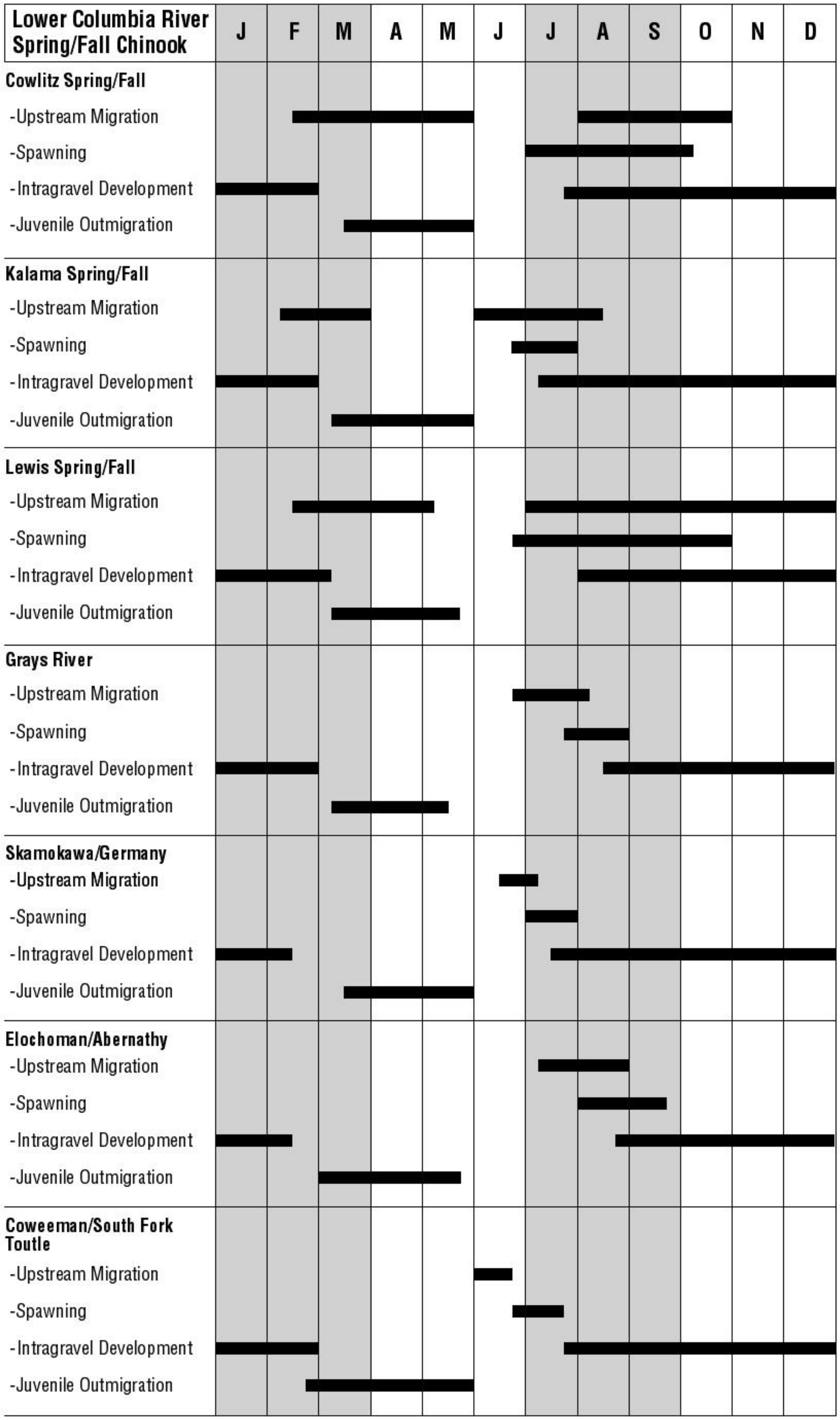
3.2.1.2 Lower Columbia River Chinook Salmon

Distribution and Condition

Chinook salmon were proposed threatened for the Lower Columbia River system on March 9, 1998. The official listing took place on March 24, 1999 and covers all drainages of the Lower Columbia River. NMFS is the lead regulatory agency for this listing under the ESA. This ESU includes all native populations from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls. The eastern boundary for this ESU is Celilo Falls, which corresponds to the edge of the drier Columbia Basin ecosystem and historically may have presented a migrational barrier to Chinook salmon at certain times of the year. Most populations in this ESU are considered ocean type. Populations in this ESU tend to mature at three to four years of age. Lifecycle timing is shown in *Table 3*.

The fall-run race consists of 14 stocks located downstream of Bonneville Dam. These stocks can be further divided into 2 general groups: 1) the early spawners that have a strong hatchery influence in their lineage and 2) a later spawning group that are made up mostly of wild stock (WDFW 1993). Of the 14 Lower Columbia River fall Chinook stocks, 12 are currently classified as healthy while the 2 Toutle River stocks are considered depressed.

Table 3 Lifecycle Timing of Lower Columbia River Spring/Fall Chinook



Factors for Decline
Limiting factors in the freshwater environment include peak winter flows, spawning gravel quality and stability, and thermal barriers during upstream migration. All of these factors can be attributed, at least in some part, to the extensive logging in the tributary watersheds of the Lower Columbia Basin.

The 2 Toutle River stocks are currently depressed due largely to the 1980 eruption of Mt. St. Helens. Pre-eruption escapement numbers averaged approximately 3,000 natural spawners (Green and South Fork Toutle rivers). In 1980 and 1981 there were zero and 91 fish, respectively. Although Chinook numbers are beginning to recover, the WDFW still considers these stocks depressed due to the presently low escapement levels (WDFW 1993).

All basins are affected (to varying degrees) by habitat degradation. Major habitat problems are related primarily to blockages, forest practices, urbanization in the Portland and Vancouver areas, and agricultural activities in floodplains of main stem rivers and tributaries. Substantial Chinook salmon spawning habitat has been blocked (or passage substantially impaired) in the Cowlitz (Mayfield Dam 1963, RKm 84), Lewis (Merwin Dam 1931, RKm 31), Clackamas (North Fork Dam 1958, RKm 50), Hood (Powerdale Dam 1929, RKm 7), Sandy (Marmot Dam 1912, RKm 48), and Bull Run River dams in the early 1900s), and rivers (Myers et al. 1998).

Critical Habitat
Critical habitat was designated on February 16, 2000 to include all river reaches accessible to listed Chinook salmon in Columbia River tributaries between the Grays and White Salmon rivers in Washington and the Willamette and Hood rivers in Oregon, inclusive. Also included are adjacent riparian zones, as well as river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the Dalles Dam. Excluded are tribal lands and areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 6,338 square miles in Oregon and Washington.

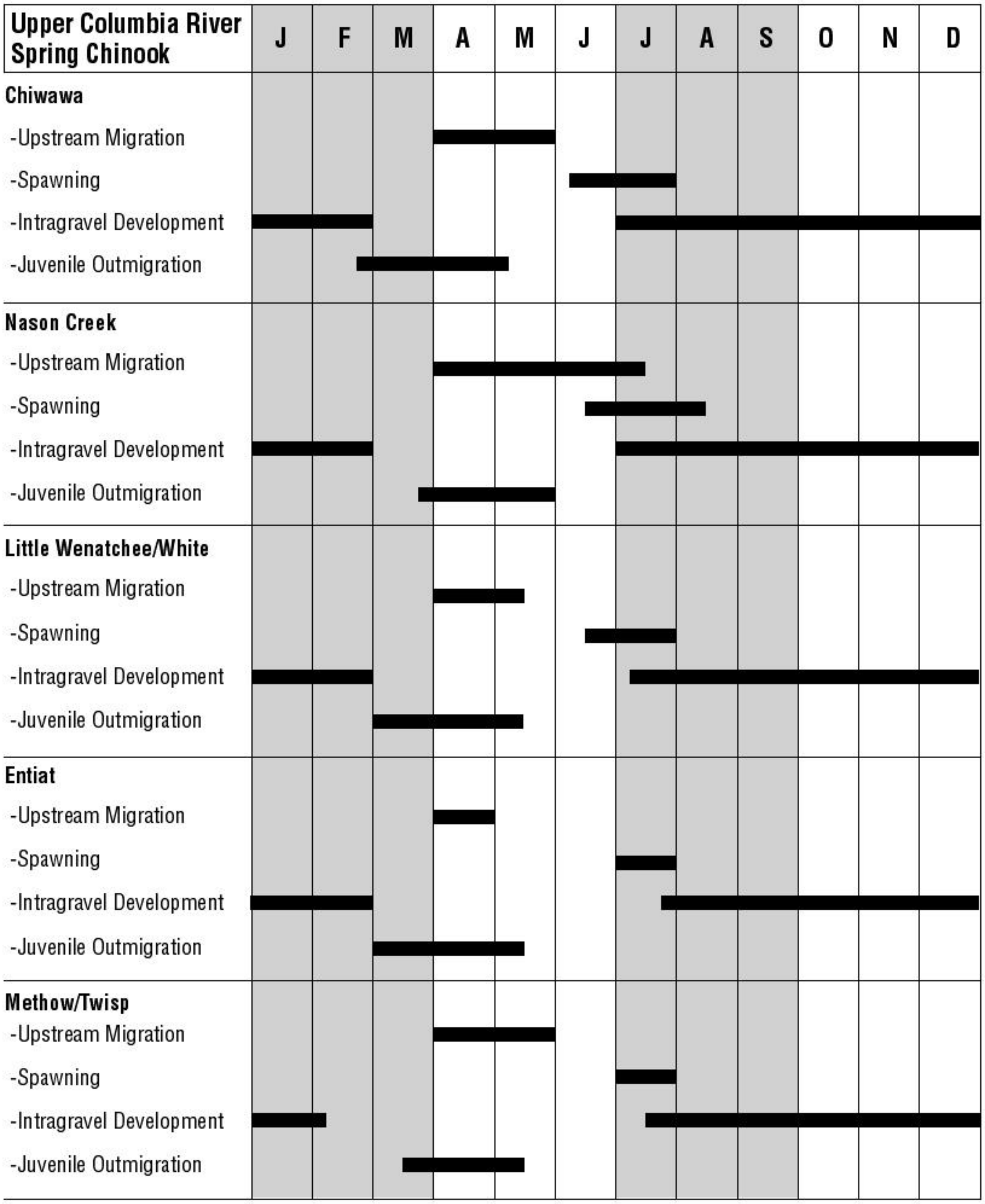
3.2.1.3 Upper Columbia River Spring Chinook Salmon

Distribution and Condition
Chinook salmon were listed endangered for the Upper Columbia River system on March 24, 1999. Once a species is listed as endangered, the take prohibition of Section 9 automatically applies. Therefore, the section 4(d) exemption from take will not apply to Upper Columbia River spring Chinook populations. NMFS is the lead regulatory agency for this listing under the ESA. This ESU includes stream-type Chinook salmon spawning above Rock Island Dam in the Wenatchee, Entiat, and Methow rivers. All Chinook salmon in the Okanogan River are apparently ocean-type and are therefore considered part of the Upper Columbia River summer and fall-run ESU. These upper Columbia River populations exhibit the classic stream-type life history strategies: yearling smolt emigration with only rare coded wire tag (CWT) recoveries in coastal fisheries (Myers et al. 1998). Morphological differences and meristic traits distinguish

stream- and ocean-types in the Columbia and Snake River basins (Schreck et al. 1986). Lifecycle timing is illustrated in Table 4.

Rivers in this ESU drain the east slopes of the Cascade Range and are fed primarily by snowmelt. The waters tend to be cooler and less turbid than the Snake and Yakima Rivers to the south. The Upper Columbia River population segment of Chinook is comprised, either in part or wholly, of five counties (Chelan, Douglas, Kittitas, Okanogan, and Skagit). There are nine distinct stocks of spring Chinook within this ESU. WDFW classifies all nine of these stocks as depressed due to long-term negative trends in escapement numbers (WDFW 1993).

Table 4 Lifecycle Timing of Upper Columbia River Spring Chinook



Factors for Decline

With Chinook salmon activity concentrated in larger rivers and streams, this species has suffered the most from the construction of dams and diversions. Upper Columbia spring Chinook must cross 7 hydroelectric dams to reach their natal tributaries. These dams create potential impasses to migration, increase the travel time upstream/downstream, and subject emigrating juveniles to intense predation and turbine mortality related to dam operation. Historic spawning grounds have been altered, destroyed, or inundated by urbanization, irrigation, and dams. Past and present hatchery practices may also contribute to the decline of wild salmon by increasing juvenile competition and diluting the genetic make-up of native Chinook (Meehan 1991).

Risks associated with interactions between wild and hatchery Chinook salmon are also a concern. For example, there continues to be substantial production of the composite, non-native Carson stock for fishery enhancement and hydropower mitigation. Estimates of hatchery contribution to natural spawning escapements are 39% in the Methow River basin (Myers et al. 1998).

Critical Habitat
Critical habitat was designated on February 16, 2000 to include all river reaches accessible to listed Chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River. Also included are adjacent riparian zones, as well as river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to Chief Joseph Dam in Washington. Excluded are tribal lands and areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 7,003 square miles in Oregon and Washington. The following counties lie partially or wholly within these basins (or contain migration corridors for the species): Oregon – Clatsop, Columbia, Hood River, Gilliam, Morrow, Sherman, Umatilla, and Wasco; Washington – Benton, Chelan, Clark, Cowlitz, Douglas, Franklin, Grant, Klickitat, Kittitas, Multnomah, Okanogan, Pacific, Skamania, Wahkiakum, Walla Walla, and Yakima.

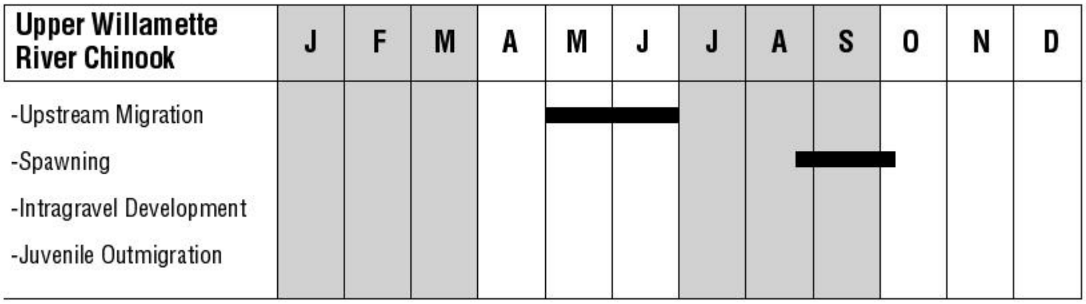
3.2.1.4 Upper Willamette River Chinook Salmon

The Upper Willamette River population segment of Chinook salmon was officially listed as a threatened species on March 24, 1999. NMFS is the lead regulatory agency for this listing under the ESA. This ESU includes naturally spawned spring-run populations above Willamette Falls. Fall Chinook salmon above the Willamette Falls are introduced and although they are naturally spawning, they are not considered a population for the purposes of defining this ESU (NMFS 1999).

Distribution and Condition
At present, NMFS recognizes the McKenzie River spring Chinook run as the only significant natural population of spring Chinook within the Upper Willamette River Chinook salmon ESU. Historically the Willamette Falls has limited access of Chinook to the upper river and thus defines the boundary of a distinct geographic region. High flows over the falls in the spring provided a window for returning spring Chinook. However, low flows in the fall prevented fish from ascending the falls in autumn.

Upper Willamette Chinook salmon are included in this analysis because of their presence during migration. They migrate along the Washington border in the Columbia River. Life cycle timing is shown in Table 5.

Table 5 Lifecycle Timing of Upper Willamette River Chinook



Factors for Decline

Major factors for decline of the Upper Willamette River Chinook salmon include habitat blockages, degradation of habitat, and genetic introgression from hatchery stocks. Habitat blockages have derived from the construction of dams and establishment of culverts throughout the range of the ESU. Substantial habitat blockages have resulted from the construction of Detroit, Big Cliff, and Green Peter dams along the Santiam River, and from flood control dams located along the main stem of the Willamette River. Other blockages from smaller dams and culverts are likely throughout the region (Busby et al. 1996).

Habitat degradation has resulted from timber harvest within most of the watersheds. Extensive urbanization and agricultural practices in the Willamette Valley have resulted in additional habitat impacts. Water temperatures and stream flows reach critical levels for salmonids in places where there are significant water withdrawals or removal of riparian vegetation. Construction of splash dams, debris removal, and stream channelization have caused additional damage to salmonid habitat (Busby et al. 1996).

Critical Habitat

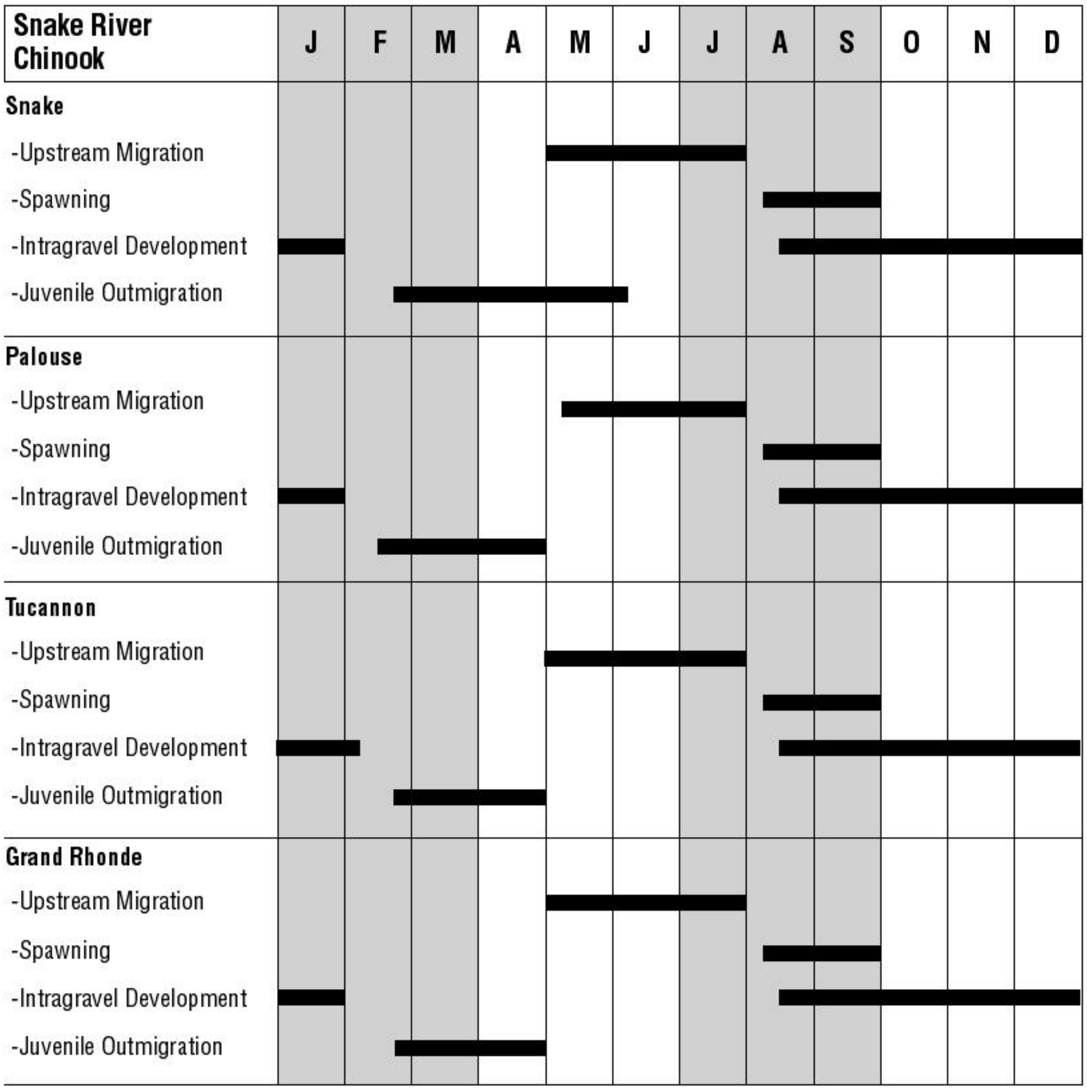
Critical habitat was designated on February 16, 2000 to include all river reaches accessible to Chinook salmon in the Willamette River and its tributaries above Willamette Falls. Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to and including the Willamette River in Oregon. Excluded are areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years) (NMFS 2000).

3.2.1.5 Snake River Chinook Salmon

On April 22, 1992 the Snake River spring, summer, and fall runs of Chinook salmon were listed as threatened. NMFS is the lead regulatory agency for this listing under the ESA. This listing covers all naturally spawning Chinook populations occurring in the main stem Snake River and any of the following sub-basins: Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River. NMFS proposed extending the ESU's geographic range on March 24, 1999. The proposed extension would include fall-run populations in the Deschutes River, Oregon.

Distribution and Condition
The Snake River population segment of Chinook is comprised, either in part or wholly, of 19 counties in Idaho, Oregon, and Washington. The Washington counties that lie within these basins include Adams, Asotin, Columbia, Franklin, Garfield, Walla Walla, and Whitman Counties. Lifecycle timing is shown in Table 6.

Table 6 Lifecycle Timing of Snake River Chinook



Factors for Decline
The Snake River runs of Chinook must cross up to ten hydroelectric dams in Washington to reach their natal tributaries. Not only do these dams create potential impasses to migrating fish, but they also create a chain of impoundments. Slow-moving water can disorient fish that are seeking flow to guide them upstream. Salmon are also subjected to increased predation, delayed migration timing, and potential mortality associated with dam operation. Historic spawning grounds have been altered, destroyed, or inundated by urbanization, irrigation, and dams.

Hatchery practices may also contribute to the decline of wild salmon by increasing juvenile competition and diluting the genetic make-up of native Chinook (Meehan 1991).

There is further habitat degradation in many areas related to forest, grazing, and mining practices, with significant factors being lack of pools, high temperatures, low flows, poor over wintering conditions, and high sediment loads. An additional source of risk to the Snake River Chinook salmon is the continued straying by non-native hatchery fish into natural production areas (Myers et al. 1998).

Critical Habitat: Spring/Summer Run
Critical habitat was designated on December 28, 1993 to include river reaches presently or historically accessible (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams) to Snake River spring/summer Chinook salmon in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) and including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to Hells Canyon Dam. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 22,390 square miles in Idaho, Oregon and Washington. The following counties lie partially or wholly within these basins: Idaho – Adams, Blaine, Custer, Idaho, Lemhi, Lewis, Nez Perce, and Valley; Oregon – Baker, Umatilla, Union, and Wallousa; Washington – Adams, Asotin, Columbia, Franklin, Garfield, Walla Walla, and Whitman.

3.2.2 Chum Salmon *(Oncorhynchus keta)*

Life History/Habitat Requirements
Chum salmon *(Oncorhynchus keta)* are generally divided into two races: 1) summer-run chum and 2) fall-run chum. These races are divided based on the timing of their upstream migration and spawning activities. Summer-run chum salmon are defined in SASSI (WDFW 1993) as fish that spawn from mid-September to mid-October. Fall-run chum salmon are defined as fish that spawn from November through December or January. Interbreeding between races is prevented by temporal isolation.

Spawning most often occurs in the lower reaches of streams and frequently within the tidal zone. Females are very territorial and aggressive towards other females who may compete for spawning space. The average area of a chum redd is 2.3 square meters and is generally found in riffles with a medium to fine gravel substrate (Reiser and Bjornn 1979). Average fecundity for chum salmon females is about 3,000 eggs. Depending on water temperature, incubation takes between 1.5 to 4.5 months with fry emergence occurring from March through May (Meehan and Bjornn 1991).

Survival of chum from egg to fry is generally less than 10% and is usually related to flow fluctuations and temperatures during incubation (Bakkala 1970). Mortality can be caused by dewatered redds, shifted gravels, redd entombment from sedimentation, and lethal water temperatures. Water temperatures above 24°C are lethal; the preferred temperatures are 12 to

14°C (Meehan and Bjornn, 1991). Following emergence, chum salmon juveniles spend a few days to several weeks in the stream environment and migrate to the estuarine/ocean environment at night in April and May.

Chum salmon feed in the ocean environment from two to six years. Most adult spawners, however, are three to four years old. In the northern part of their range, they tend to spend more time in salt water and spawn at an older age (Helle 1984).

3.2.2.1 Hood Canal Summer-Run Chum Salmon

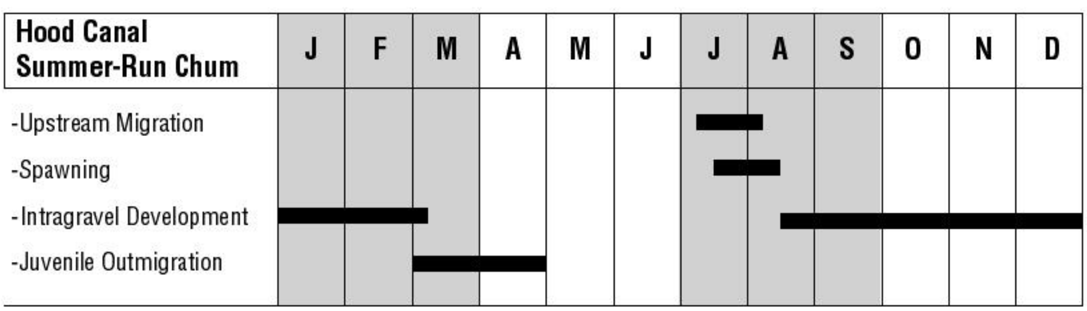
Chum salmon were proposed as threatened for the Hood Canal drainages in March 1998. The official listing took place on March 25, 1999 and covers all Hood Canal drainages. NMFS is the lead regulatory agency for this listing under the ESA. This ESU includes summer-run chum salmon populations in Hood Canal in Puget Sound and in Discovery and Sequim Bays on the Strait of Juan de Fuca. It may also include summer-run fish in the Dungeness River, but the existence of that run is uncertain.

Distribution and Condition

In Hood Canal, summer chum are a unique stock of fish, isolated from other Puget Sound stocks by distinct spatial and temporal separation. Electrophoretic studies conducted by WDFW confirm distinct genetic differences between the Hood Canal and Puget Sound chum stocks. Hood Canal summer chum spawn primarily in the Dosewallips, Duckabush, Hamma Hamma, and Big Quilcene Rivers (WDFW 1993), but the ESU includes naturally spawning chum as far north as the Dungeness River and south to the Skokomish and Union Rivers. Lifecycle timing is shown in Table 7.

The 1992 SASSI classifies this stock as critical. The Hood Canal summer chum numbered over 40,000 in 1968. The 1991 estimate for this stock was 703 (WDFW 1993). Additional spawning information shows that escapement levels have been chronically low since 1980.

Table 7 Lifecycle Timing of Hood Canal Summer-Run Chum



Factors for Decline

There are a number of reasons for the continued decline of Hood Canal summer-run chum. Low survival-to-emergence (STE) from the gravel (usually less than 10%) and habitat degradation to spawning habitats is key factors for their decline. The mouth of the Quilcene River, for example, has a serious gravel aggradation and compaction problem. The cause of this problem was the channelizing and diking of the river in the town of Quilcene (WDFW 1993). Additionally, water withdrawal and rural development has increased as timberland continues to be converted into one to five acre residential lots.

Although there are no fisheries directed specifically at Hood Canal summer-run chum, these early-migrating fish are commingled with other returning species such as sockeye, Chinook, and Coho salmon. Puget Sound and Canadian commercial fishers incidentally harvest small numbers of summer chum and could indirectly contribute to the continued decline.

Critical Habitat

Critical habitat was designated on February 16, 2000 to include all river reaches accessible to listed chum salmon (including estuarine areas and tributaries) draining into Hood Canal as well as Olympic Peninsula rivers between and including Hood Canal and Dungeness Bay, Washington. Also included are adjacent riparian zones, estuarine and marine areas of Hood Canal, Admiralty Inlet, and the Straits of Juan De Fuca to the international boundary as far west as a straight line extending north from Dungeness Bay. Excluded are tribal lands and areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 1,753 square miles in Washington.

3.2.2.2 Columbia River Chum Salmon

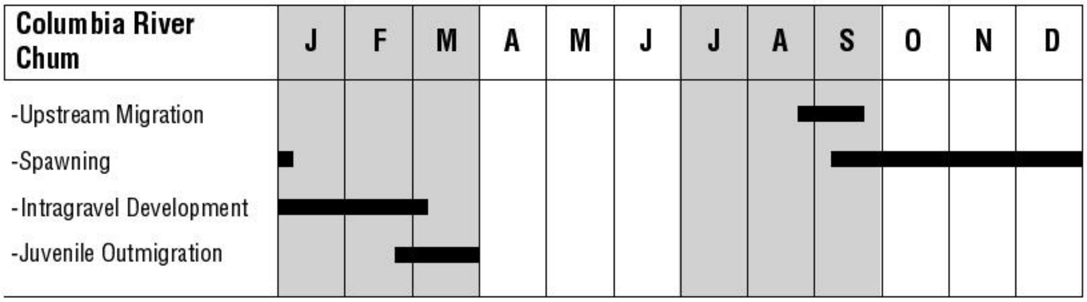
Chum salmon were proposed threatened for the Columbia River drainages in March 1998. The official listing took place on March 25, 1999 and covers all naturally spawning chum populations in the Columbia River and its tributaries in Washington and Oregon. NMFS is the lead regulatory agency for this listing under the ESA.

Distribution and Condition

Historically, chum salmon were abundant in the lower reaches of the Columbia River and may have spawned as far upstream as the Walla Walla River (over 500 km inland). Today only remnant chum salmon populations exist, concentrated in the Grays River system near the mouth, and tributaries near Bonneville Dam. Minor numbers cross Bonneville Dam in some years (WDFW 1993). Lifecycle timing is shown in Table 8.

The three distinct chum stocks (Grays River, Hamilton Creek, Hardy Creek) are native. Some non-native supplementations have been attempted without success. Currently, the Grays River and Hamilton Creek stocks are classified as depressed and the Hardy Creek stock is considered healthy.

Table 8 Lifecycle Timing of Columbia River Chum



Factors for Decline

There are a number of reasons for the continued decline of lower Columbia River fall-run chum. Poor gravel quality and gravel instability can greatly reduce the STE for chum fry. Slope failures as a result of extensive logging and road building have been the cause of sedimentation and bed aggradation. Although there are no fisheries directed specifically at Columbia River-run chum, these fish are commingled with other returning species such as Coho and may be the subject of incidental harvest.

Current abundance is probably less than 1% of historic levels, and the ESU has undoubtedly lost some (perhaps much) of its original genetic diversity. Each of the three remaining populations may have been influenced by hatchery programs and/or introduced stocks, but information on hatchery-wild interactions is unavailable.

Critical Habitat

Critical habitat was designated on February 16, 2000, to include all river reaches accessible to listed chum salmon (including estuarine areas and tributaries) in the Columbia River downstream from Bonneville Dam, excluding Oregon tributaries upstream of Milton Creek at river km 144 near the town of St. Helens. Also included are adjacent riparian zones. Excluded are tribal lands and areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 4,426 square miles in Oregon and Washington.

3.2.3 Sockeye Salmon *(Oncorhynchus nerka)*

Life History

Sockeye salmon possess one of the most complex life histories of any Pacific salmon species because of the variability in freshwater residence time (1 to 3 years in fresh water). In addition, the species *Oncorhynchus nerka* occurs in two forms: 1) the anadromous sockeye salmon and 2) the resident kokanee. Both forms of this species require a lacustrine environment for part or all of their lifecycle. The anadromous sockeye typically spend their first year of life (occasionally longer) in a rearing lake before migrating to the ocean to mature. Ocean residency can range from one to three years, with returning adults beginning their upstream migration as early as mid-March.

Spawning generally occurs from November through early February either in streams flowing into a lake, in spring-fed gravel areas along lake shores, or in the upper reaches of lake outlet streams. Spawning sites selected by sockeye vary widely, but usually contain medium to small-sized gravels through which a steady flow of water can be maintained (Meehan and Bjornn 1991). Redd sizes average up to 20 square feet (Reiser and Bjornn 1979).

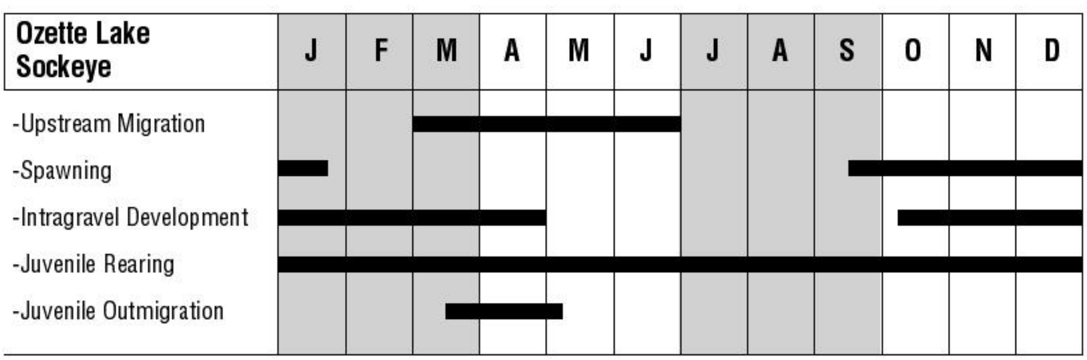
Sockeye females may have a fecundity of up to 4,000 eggs. Depending upon water temperature, the incubation period may last from 8 to 12 weeks. The alevins remain in the gravel for another two to six weeks before emerging. The fully formed, free swimming fry emerge from the gravel in April and May (Wydoski and Whitney 1979).

3.2.3.1 Ozette Lake Sockeye Salmon

The Ozette Lake sockeye salmon were proposed threatened in March 1998. NMFS is the lead regulatory agency for this listing under the ESA. The official listing took place on March 25, 1999 and covers all sockeye salmon in the Ozette Lake Basin.

Distribution and Condition
This stock of sockeye is of a native origin and is geographically distinct from other sockeye stocks. The 1992 Washington State SASSI classifies this stock as depressed based on chronically low escapement levels. Between 1926 and 1949, annual returns ranged from 2,000 to 20,000 fish. Currently, over the last 5 years, an average of about 600 fish have returned annually to spawn. The run has been declining at a rate of approximately 2% a year since 1977 (Gustafson et al. 1997). The stock is supplemented with 40,000 to 100,000 fry taken from adult sockeye caught on Ozette Lake spawning beds (WDFW 1993). The fry are reared at the Makah Tribal Hatchery on Umbrella Creek. Lifecycle timing is shown in Table 9.

Table 9 Lifecycle Timing of Ozette Lake Sockeye



Factors for Decline
The Ozette watershed has been intensively and extensively logged, causing habitat degradation to the lake and its tributaries. An increase in the fine sediment load and associated changes in channel features may be the worst effects of the prior timber harvest. Historically, spawning was much more widespread in the lake and tributaries than it is currently. Today, most of the spawning occurs in Allen’s Bay and the north shore of Elk Creek (WDFW 1993). Both of these

areas are in the southern portion of Ozette Lake where siltation is less than elsewhere in the watershed.

High water temperatures are also a contributing factor leading to the decline of this stock of sockeye. Thermographs in Crooked Creek and Big Creek in 1990 recorded temperatures as high as 18°C. A thermograph was placed in lower Umbrella Creek in 1993 by the Olympic National Park staff. Temperatures were recorded as high as 21.8°C. In addition, sockeye fry cannot be reared at the Makah Hatchery facility when summer temperatures and low water supply conditions occur (WDFW 1993).

Critical Habitat
Critical habitat was designated on February 16, 2000 to include all lake areas and river reaches accessible to sockeye salmon in Ozette Lake basin. Excluded are areas above specific dams or above longstanding, naturally impassable barriers (i.e. natural falls). Major river basins containing spawning and rearing habitat for this ESU encompasses approximately 88 square miles.

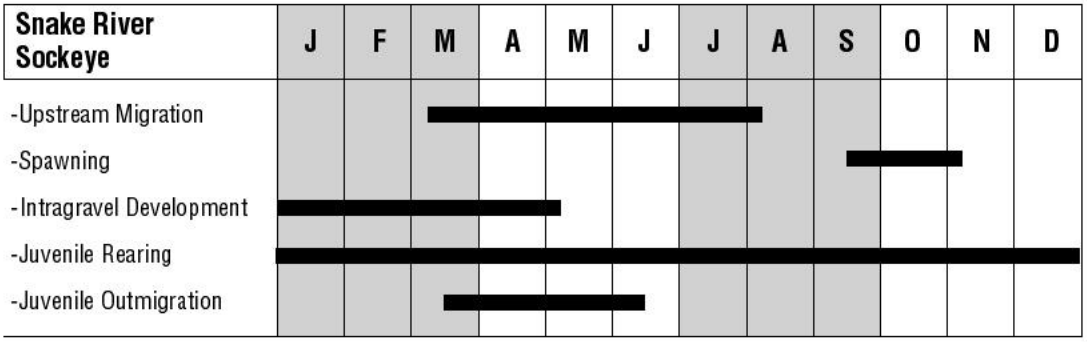
3.2.3.2 Snake River Sockeye Salmon

The sockeye salmon was listed as endangered for the Snake River system on November 20, 1991. Once a species is listed as endangered, the take prohibition of Section 9 automatically applies. Therefore, the Section 4(d) exemption from take will not apply to the Snake River sockeye salmon populations. NMFS is the lead regulatory agency for this listing under the ESA. This listing covers all naturally spawning sockeye populations occurring in the Snake River basin in Idaho.

Distribution and Condition
The spawning grounds of the Snake River sockeye are located in Redfish Lake, Idaho. Redfish Lake is located about 900 miles inland near the head of the middle fork of the Salmon River. These spawning areas occur many miles upstream from Washington State. The fish occur in Washington only during migration along the Columbia and Snake Rivers.

This stock of sockeye is of a native origin and is geographically distinct from other sockeye stocks (NMFS 1991a). SASSI identifies this stock as functionally extinct based on the return of so few adults to the spawning grounds (NMFS 1991a). Lifecycle timing is illustrated in Table 10.

Table 10 Lifecycle Timing of Snake River Sockeye



Factors for Decline

Snake River sockeye salmon have suffered the most from the construction of dams and diversions. Not only do these dams create potential impasses to migrating fish, but they also create a chain of impoundments. Slow-moving water can disorient fish that seek flow to guide them upstream. Historic spawning grounds have been altered, destroyed, or inundated by urbanization, irrigation, and dams. Past hatchery practices may have also contributed to the decline of wild salmon by increasing juvenile competition and diluting the genetic make-up of native salmon (Meehan 1991).

Predation on migrating juveniles within dam reservoirs is another factor affecting sockeye populations. Slow-moving water can disorient migrating fish and increase the risk of predation.

Further habitat degradation related to forest, grazing, agriculture, and mining practices have also had an impact on sockeye salmon habitat. These activities have contributed to the reduction of pools, increase in water temperatures, reduction of flows, and increase of sediment loads.

Critical Habitat

Critical habitat was designated on December 28, 1993 and includes river reaches presently or historically accessible (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams) to Snake River sockeye salmon in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) and including all Columbia River estuarine areas and river reaches upstream to the confluence of the Columbia and Snake rivers; all Snake River reaches from the confluence of the Columbia River upstream to the confluence of the Salmon River; all Salmon River reaches from the confluence of the Snake River upstream to Alturas Lake Creek; Stanley, Redfish, Yellow Belly, Pettit, and Alturas Lakes (including their inlet and outlet creeks); Alturas Lake Creek, and that portion of Valley Creek between Stanley Lake Creek and the Salmon River. Watersheds containing spawning and rearing habitat for this ESU comprise approximately 510 square miles in Idaho. The watersheds lie partially or wholly within the following counties: Blaine and Custer (NMFS 2000).

3.2.4 Steelhead *(Oncorhynchus mykiss)*

Life History

Steelhead *(Oncorhynchus mykiss)* occur in two forms: 1) the anadromous steelhead and 2) the resident rainbow trout. The steelhead can be further divided between two genetically distinct groups: a coastal group and an inland group. Steelhead in the Upper Columbia River ESU, for example, are of the inland group, and fish from the Lower Columbia ESU are of the coastal group.

The life histories of steelhead can vary considerably. Juveniles spend one to four years in the freshwater environment (up to seven years in the Methow River, for example) before migrating to sea. Migration to the sea appears to be controlled by changes in photoperiod, but is also partly influenced by stream flows, water temperatures, and the lunar phase (Bjornn 1971). The out migration generally occurs in the spring (April-June); they spend up to four years maturing in the productive feeding grounds of the ocean. Their ultimate size is directly related to the duration of their ocean residency. Adult steelhead spawners are divided into two races depending on the time of year they enter fresh water: summer-run and winter-run. Winter-run steelhead enter the rivers between November and April, whereas summer-run steelhead begin their migration from May to November (Busby et al. 1996).

Summer-run steelhead generally enter freshwater between June and September, and spawn the following spring. Winter-run fish enter the rivers from December to February and spawn shortly thereafter. Steelhead are very strong swimmers and jumpers. This swimming ability allows them to spawn in small headwater streams as well as larger rivers. Average redd size is approximately 50 square feet with a preferred water temperature of 3.9° to 9.4°C (Reiser and Bjornn 1979). The fecundity of steelhead is related to the size and age of the fish, but averages 2,000 to 5,000 eggs (Wydoski and Whitney 1979).

Steelhead are iteroparous; they do not invariably die after spawning. However, the physiological processes that occur in anadromous fish lead to substantial post-spawning mortality of adults (Meehan 1991). In large drainages such as the Columbia River, the proportion of fish that live to spawn a second time is very low (usually less than 10%).

Eggs may take from four to six weeks to hatch, depending upon water temperatures. The alevins remain in the gravel for up to three more weeks while completely absorbing their yolk-sac. After emergence from the gravel, steelhead fry are heavily dependent upon streamside vegetation and submerged cover for protection from predators.

Variability in the life history patterns of the Upper Columbia River steelhead ESU is apparent when comparing fish from different watersheds within the ESU. Some juveniles in the Methow River, for example, may spend up to seven years in freshwater before smolting. Steelhead in the Mad River and Entiat River spend two years in freshwater followed by only one year in the ocean. Fish from the Wenatchee Basin (including Mission Creek, Peshastin Creek, Icicle Creek, Nason Creek, White River, and Chiwawa River) spend an average of two years in freshwater and two years in saltwater followed by another year in freshwater before spawning.

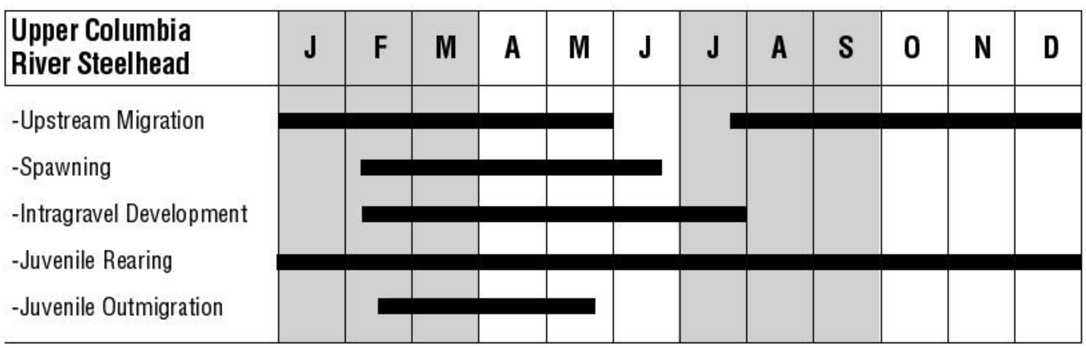
3.2.4.1 Upper Columbia River Steelhead

The Upper Columbia River population segment of steelhead salmon was officially listed as endangered on August 18, 1997. Once a species is listed as endangered, the take prohibition of Section 9 automatically applies. Therefore, the Section 4(d) exemption from take will not apply to Upper Columbia River Steelhead populations. NMFS is the lead regulatory agency for this listing under the ESA. The ESU includes all naturally spawned populations of steelhead (and their progeny) in streams of the Columbia River basin upstream from the confluence with the Yakima River to the International Border. The Wells Hatchery stock of steelhead are also part of the listed ESU.

Distribution and Condition

There are three distinct stocks of steelhead within the Upper Columbia River ESU. They include the Wenatchee, Entiat, and Methow/Okanogan stocks of summer steelhead. The original stocks were native; however, some interbreeding with non-native steelhead has occurred and they are now classified as mixed stocks. All three of these stocks are further classified as depressed by WDFW based on fish counts at the Prosser Dam, creel surveys of sport harvest, and escapement numbers. Lifecycle timing is shown in Table 11.

Table 11 Life Cycle Timing of Upper Columbia River Steelhead



Factors for Decline

The principal factors affecting production within this ESU are the eight hydroelectric dam facilities downstream of the Entiat (which account for 94% of human-caused fish mortalities), irrigation diversions/withdrawals, degraded riparian habitat, low in-stream flows, and high water temperatures (WDFW 1993). Although the sport harvest of wild summer steelhead has been prohibited since 1986, commercial harvest continues in the lower main stem Columbia River and results in an impact to 10 to 15% of these stocks (WDFW 1993). The major present threat to genetic integrity for steelhead in this ESU comes from past and present hatchery practices. The stocks above Rock Island Dam are largely driven by hatchery production. Although the major hatchery production in these rivers have been derived from stocks indigenous to the ESU, there are distinct genetic risks associated with hatchery supplementation (Busby et al. 1996).

Critical Habitat

Critical habitat was designated on February 16, 2000 to include all river reaches accessible to listed steelhead in Columbia River tributaries upstream of the Yakima River, Washington, and downstream of Chief Joseph Dam. Also included are adjacent riparian zones, as well as river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to Chief Joseph Dam in Washington. Excluded are tribal lands and areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 9,545 square miles in Washington.

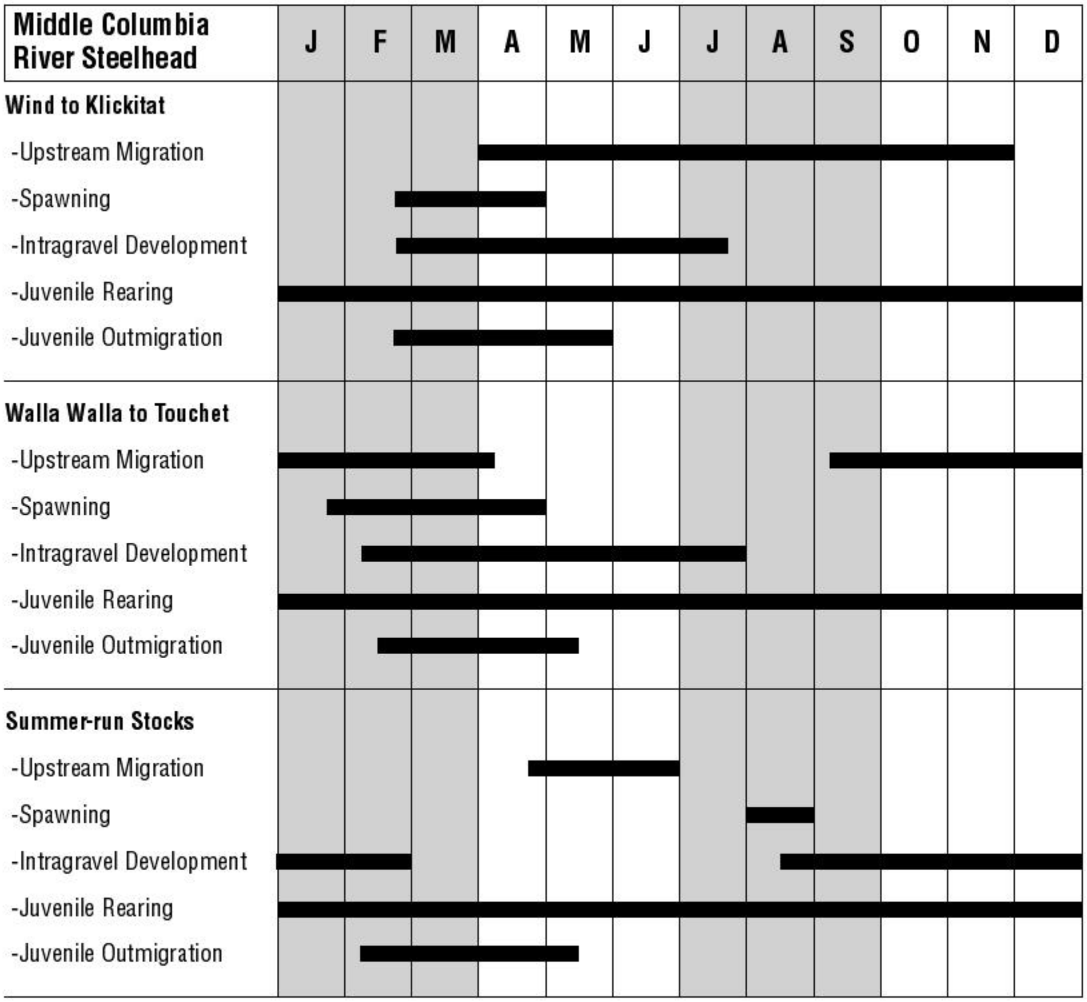
3.2.4.2 Middle Columbia River Steelhead

The Middle Columbia River population segment of steelhead salmon was officially listed as a threatened species on March 25, 1999. NMFS is the lead regulatory agency for this listing under the ESA. The ESU includes all naturally spawned populations of steelhead (and their progeny) from the Wind River, Washington upstream to the Yakima River. Excluded are steelhead from the Snake River Basin which are listed as threatened under a separate ESU.

Distribution and Condition

The middle Columbia River population segment of steelhead is made up, either in part or wholly, of 10 Washington State counties and 15 Oregon counties. The Washington counties are these: Benton, Chelan, Columbia, Franklin, King, Kittitas, Klickitat, Skamania, Walla Walla, and Yakima. There are 15 distinct stocks of steelhead within the middle Columbia ESU. Three of these stocks are winter-run steelhead: Wind River, White Salmon River, and Klickitat River. The remaining 12 are summer-run steelhead: Wind River, Panther Creek, Trout Creek, White Salmon River, Klickitat, Rock Creek, Walla Walla River, Touchet, Tucannon, Asotin Creek, Grande Ronde, and Yakima River. Life cycle timing is shown in Table 12.

Table 12 Lifecycle Timing of Middle Columbia River Steelhead



Thirteen stocks within this ESU are classified as depressed by WDFW. Based on chronically low escapement, 2 stocks are currently considered unknown due to a lack of sufficient data to make a determination.

Factors for Decline

The principal factors affecting production within this ESU are the hydroelectric dam facilities (which account for 94% of human-caused fish mortalities), irrigation diversions/withdrawals, degraded riparian habitat, low in stream flows, and high water temperatures (WDFW 1993).

Other habitat blockages in this ESU include Pelton Dam on the Deschutes River, minor blockages from smaller dams, and impassable culverts. Several dams in the John Day River basin previously blocked habitat, but they have since been modified with ladders (NMFS Publications); however, there is a possibility that local native stocks were exterminated before these ladders were built.

In the stream segments inventoried within this ESU, riparian restoration is needed for between 37% and 84% of the river bank in various basins. In stream habitat is also affected by these same factors, as well as by past gold dredging and severe sedimentation due to poor land management practices (Busby et al. 1996).

Critical Habitat

Critical habitat was designated on February 16, 2000 to include all river reaches accessible to listed steelhead in Columbia River tributaries (except the Snake River) between Mosier Creek in Oregon and the Yakima River in Washington (inclusive). Also included are adjacent riparian zones, as well as river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the Yakima River in Washington. Excluded are tribal lands and areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 26,739 square miles in Oregon and Washington.

3.2.4.3 Lower Columbia River Steelhead

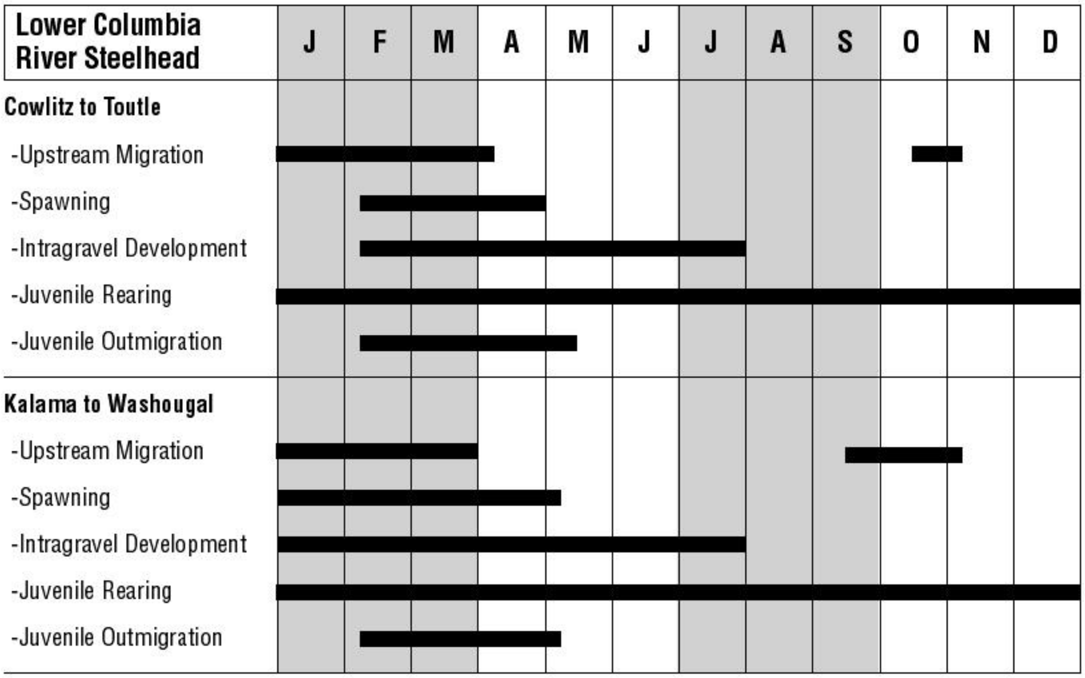
The Lower Columbia River population segment of steelhead salmon was officially listed as a threatened species on March 19, 1998. NMFS is the lead regulatory agency for this listing under the ESA. The ESU includes all naturally spawned populations of steelhead (and their progeny) from the Wind River downstream to the Cowlitz River. Excluded are steelhead from the Little White Salmon and Big White Salmon rivers.

Distribution and Condition

The Lower Columbia River population segment of steelhead is made up, either in part or wholly, of six Washington State counties and seven Oregon counties. The Washington counties are: Clark, Cowlitz, Lewis, Pacific, Skamania and Wahkiakum. Non-anadromous *O. mykiss* co-occur with the anadromous form in Lower Columbia River tributaries; however, the relationship between these forms in this geographic area is unclear. Life history attributes for steelhead within this ESU appear to be similar to those of other west coast steelhead (Busby et al. 1996). Lifecycle timing is shown in Table 13.

This ESU contains 12 distinct stocks of summer and winter steelhead. Seven of these are classified by WDFW as depressed because of chronically low escapement numbers or severe short-term declines. Three stocks are considered unknown due to a lack of sufficient data, while two stocks (South Fork Toutle River and Kalama River winter-run fish) are classified as healthy.

Table 13 Lifecycle Timing of Lower Columbia River Steelhead



Factors for Decline

Factors affecting steelhead production include the following: past and present logging, incidental harvest through commercial fisheries, predation of smolts and returning adults, low ocean productivity, construction of dams in certain watersheds (Mayfield Dam, Merwin Dam), urbanization, and water quality. Also, the 1980 eruption of Mt. St. Helens caused severe habitat degradation in some watersheds within this ESU (North and South Fork Toutle).

Significant habitat blockages occur as a result of dams on the Sandy River, and minor blockages (such as impassable culverts) throughout the region. Habitat problems for most stocks in this ESU are similar to those in adjacent coastal ESUs. Clear-cut logging has been extensive throughout most watersheds in this area, and urbanization is a substantial concern in the Portland and Vancouver areas. Because of their limited distribution in upper tributaries, summer steelhead appear to be at more risk from habitat degradation than are winter steelhead (Busby et al. 1996).

Critical Habitat

Critical habitat was designated on February 16, 2000 to include all river reaches accessible to listed steelhead in Columbia River tributaries between the Cowlitz and Wind rivers in Washington and the Willamette and Hood Rivers in Oregon, inclusive. Also included are adjacent riparian zones, as well as river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the Hood River in Oregon. Excluded are tribal lands and areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 5,017 square miles in Oregon and Washington.

3.2.4.4 Upper Willamette River Steelhead

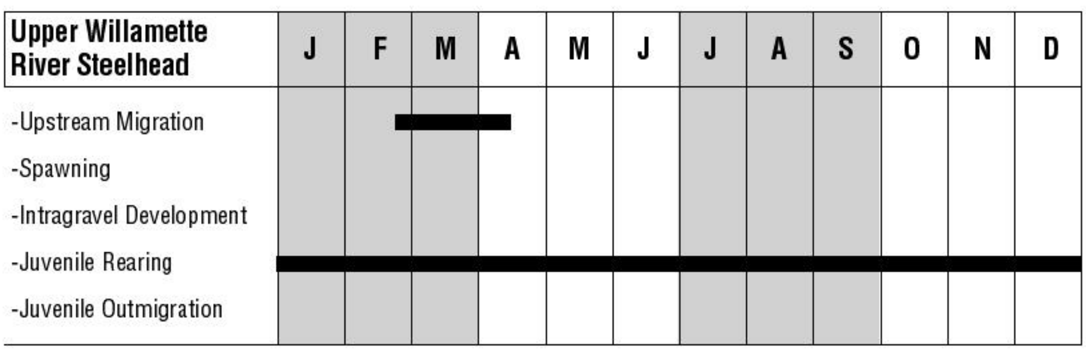
The Upper Willamette River population segment of steelhead was officially listed as a threatened species on March 25, 1999. NMFS is the lead regulatory agency for this listing under the ESA. This ESU includes all naturally spawned populations of winter-run steelhead in the Willamette River and its tributaries upstream from Willamette Falls to the Calapooia River.

Distribution and Condition

At present, NMFS recognizes only naturally spawned, winter steelhead trout as part of this ESU. Where distinguishable, naturally spawned, summer-run steelhead trout are not included in this listed ESU (NMFS 1999). Historically, the Willamette Falls has limited access of steelhead trout to the upper river and thus defines the boundary of a distinct geographic region. Steelhead trout from the Upper Willamette River are genetically distinct from those in the lower river. Reproductive isolation from lower river populations may have been facilitated by Willamette Falls, which is known to be a migration barrier to some anadromous salmonids. For example, winter steelhead and spring Chinook salmon occurred historically above the falls, but summer steelhead, fall Chinook salmon, and Coho salmon did not (Busby et al. 1996). Lifecycle timing is shown in Table 14.

Upper Willamette River steelhead are included in this analysis because of their presence during migration. They migrate along the Washington border in the Columbia River.

Table 14 Lifecycle Timing of Upper Willamette River Steelhead



Factors for Decline

Major factors for decline of the Upper Willamette River steelhead include habitat blockages, degradation of habitat, and genetic introgression. Habitat blockages have derived from the construction of dams and establishment of culverts throughout the range of the ESU. Substantial habitat blockages have resulted from the construction of Detroit, Big Cliff, and the Green Peter Dams along the Santiam River, and from flood control dams located along the main stem of the Willamette River. Other blockages from smaller dams and culverts are likely throughout the region (Busby et al. 1996).

Habitat degradation has resulted from timber harvest within most of the watersheds. Extensive urbanization and agricultural practices in the Willamette Valley have resulted in additional habitat impacts. Water temperatures and stream flows reach critical levels for salmonids in places where there are significant water withdrawals or removal of riparian vegetation. Construction of splash dams, debris removal, and stream channelization have caused additional damage to salmonid habitat (Busby et al. 1996).

Past and present hatchery practices have presented a threat to the genetic integrity of the stock. Although there is some separation in run timing between hatchery and wild winter steelhead, enough overlap in spawning appears to occur to allow genetic mixing (Busby et al. 1996).

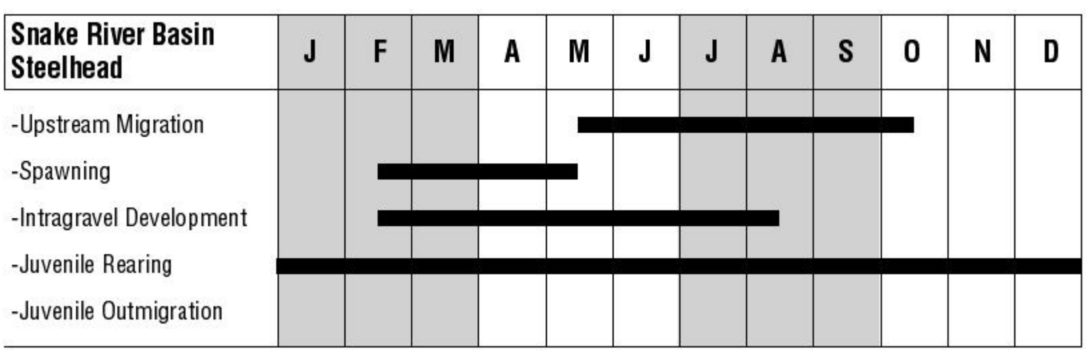
Critical Habitat
Designated critical habitat includes all river reaches accessible to steelhead trout in the Willamette River and its tributaries above Willamette Falls. Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to and including the Willamette River in Oregon. Excluded are areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years) (NMFS 2000).

3.2.4.5 Snake River Basin Steelhead

The Snake River basin population segment of steelhead was officially listed as a threatened species on August 18, 1997. NMFS is the lead regulatory agency for this listing under the ESA. The ESU includes all naturally spawned populations of steelhead (and their progeny) in streams in the Snake River Basin of southeast Washington, northeast Oregon, and Idaho.

Distribution and Condition
Major river basins containing spawning and rearing habitat for Snake River Basin steelhead cover approximately 29,282 square miles in Idaho, Oregon, and Washington. The following counties contain spawning, rearing, and migration habitat: Idaho – Adams, Blaine, Boise, Clearwater, Custer, Idaho, Latah, Lemhi, Lewis, Nez Perce, and Valley; Oregon – Baker, Clatsop, Columbia, Hood River, Morrow, Multnomah, Sherman, Umatilla, Union, Wallowa, and Wasco; Washington – Asotin, Benton, Clark, Columbia, Cowlitz, Franklin, Garfield, Gilliam, Klickitat, Skamania, Wahkiakum, Walla Walla, and Whitman (NMFS 2000). Snake River Basin steelhead also occur along the Lower Columbia River during migration. Lifecycle timing is shown in Table 15.

Table 15 Lifecycle Timing of Snake River Basin Steelhead



Factors for Decline
Major factors for decline of the Snake River basin steelhead include habitat blockages, habitat degradation, and genetic introgression from hatchery stocks. One of the most significant habitat problems facing steelhead in this ESU is substantial modification of the migration corridor by hydroelectric power development in the main stem Snake and Columbia rivers. The Hells Canyon Dam complex on the main stem Snake River and the Dworshak Dam on the North Fork Clearwater River pose significant migration impediments. Several minor blockages from smaller dams, impassable culverts, and other unnatural barriers are likely to occur throughout the range of the ESU (Busby et al. 1996). High summer and low winter temperatures are limiting for salmonids in many streams in eastern Oregon. Flows below recommended levels occur in the Grande Ronde River, especially in the late fall through early spring. Water withdrawals and low flows are severe in several areas of that basin (Busby et al. 1996).

Agricultural practices, timber harvest, road building, and channelization have resulted in impacts to steelhead habitat. Steelhead spawning areas have been degraded by overgrazing, past gold dredging, and severe sedimentation due to poor land management practices (Busby et al. 1996).

Critical Habitat
Designated and critical habitat include all river reaches accessible to listed steelhead in the Snake River and its tributaries in Idaho, Oregon, and Washington. Also included are adjacent riparian zones, as well as river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the confluence with the Snake River. Excluded are tribal lands and areas above specific dams identified or above longstanding, naturally impassable barriers (i.e., Napias Creek Falls and other natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 5,017 square miles in Idaho.

3.2.5 Bull Trout *(Salvelinus confluentus)*

USFWS is the lead regulatory agency for the listing of bull trout under the ESA. USFWS has implemented a standing prohibition on the take of threatened species (codified at 50 CFR 17.31(a)) under Section 4(d) of the ESA. Take prohibitions automatically apply when the USFWS lists a species as threatened, such as the bull trout. When USFWS promulgates a detailed 4(d) rule for threatened species, it is called a “special 4(d) rule” to distinguish it from the standing USFWS regulation prohibiting the take of threatened species. If deemed appropriate by USFWS, a special 4(d) rule may be adopted to eliminate or reduce the standing regulation’s applicability to activities that may affect a particular threatened species for which USFWS is responsible. USFWS comments have been incorporated into the Regional Program; however, the there is no special 4(d) rule available at this time to reduce or eliminate take prohibitions for road maintenance activities. Bull trout are included in this analysis because of their presence within Washington, and for future consideration by USFWS to issue a special 4(d) rule.

Life History
Bull trout are native to western North America. They were historically found throughout the Pacific Northwest, from northern California to the upper Yukon, as well as Siberia and Korea.

Inland populations occur in Idaho, Montana, Utah, Nevada, and Alberta. Bull trout may be extirpated in California, and have generally declined in numbers throughout much of their range. In Washington, bull trout are generally present in all parts of the state except for the extreme southeast and southwest areas.

Bull trout exhibit four basic life history strategies: anadromous, ad fluvial, fluvial, and resident. All four life-forms can be long lived (up to 10+ years) and all are iteroparous. Resident fish spend their entire life cycle in low order stream systems, exhibiting little or no seasonal migrations. Fluvial fish migrate downstream to feed in larger rivers; these fish are considerably larger than resident fish due to the increased food production in higher order rivers. Ad fluvial fish are similar to fluvial fish, but migrate downstream to take up residence in a lacustrine environment. In the Northwest, for example, ad fluvial bull trout populations are found in Baker Lake, Chester Morse Lake, and above the Gorge Dam on the Skagit River (WDFW 1998).

The anadromous life form is more complex than the other three forms. Upstream and downstream migration timing can vary considerably, as shown in *Table 16.* Smolts typically move out to Puget Sound as early as late February but usually in April, May and early June, spending the remaining spring and summer months in the marine environment. They then return to the lower main stem rivers to begin their spawning migration in the late summer of that same year (Kraemer 1994).

Adult bull trout spawn in the upper portion of watersheds. In most cases, anadromous bull trout define the upper limit of anadromous use in a watershed. Large adults have been documented over 120 river miles inland at an elevation of over 3,200 feet (Kraemer 1994). Spawning in the north Puget Sound drainages has been observed as early as August and as late as November. Females deposit anywhere from a few hundred to 5,000 eggs in their redds, depending on their size. The embryos incubate until spring; the surviving fry emerge from redds in April through May.

Temperature may be the most important factor affecting bull trout distribution. Water temperatures in excess of 15°C are thought to limit bull trout distribution (Rieman and McIntyre 1993). Bull trout spawning is more dependent on temperature than time of year; stream temperatures must drop below 8°C for spawning to commence. Spawning activities usually stop or slow if stream temperatures rise above 8°C (Kraemer 1994). Water temperature also appears to be a critical factor for egg development. McPhail and Murray (1979) found that the survival to emergence for bull trout varied with water temperature: 0 to 20% survival in 8 to 10°C, 60 to 90% in 6°C, and 80 to 95% in 2 to 4°C.

The substrate and water depth can vary greatly between spawning sites. However, spawning generally occurs in uniform substrate 0.2 to 2.0 inches in diameter and water from eight inches to two feet deep. Depending on water temperature, incubation takes about 130 days; embryo development requires the accumulation of about 635 temperature units (Meehan 1991). Eggs hatch around the end of January but the alevins may remain in the gravel until April. This extended rearing within the interstitial spaces of the gravel makes bull trout very sensitive to increased sediment loads.

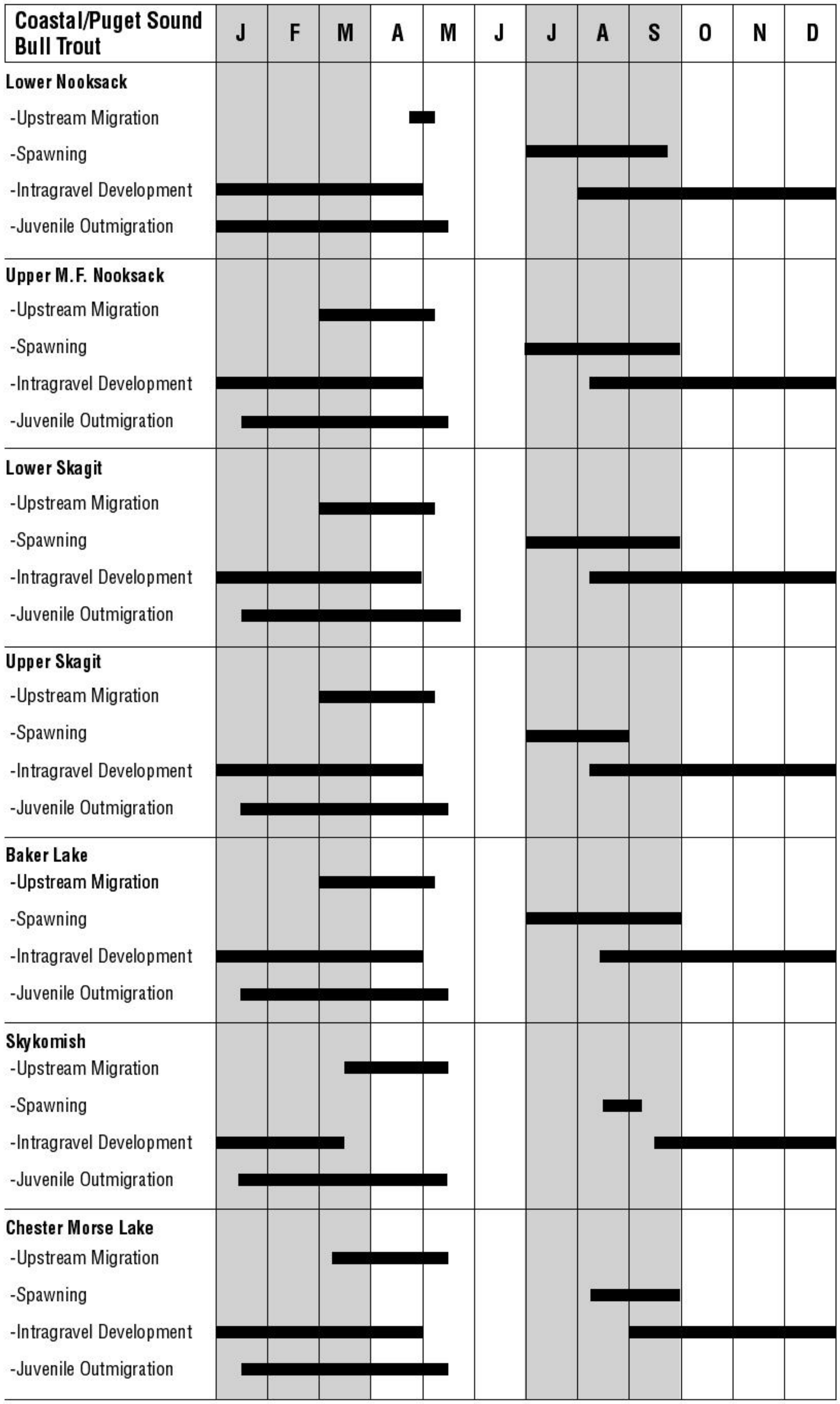
3.2.5.1 Coastal/Puget Sound Bull Trout

Bull trout were officially listed as a threatened species on November 1, 1999. Dolly Varden were officially proposed threatened due to similarity of appearance to bull trout on January 9, 2001; the final determination is expected in the winter of 2001. USFWS is the lead regulatory agency for this listing under the ESA.

Distribution and Condition

There are 30 distinct bull trout populations within the Coastal/Puget Sound ESU. Of those 30 populations, the stock status of five populations is categorized as healthy. The remaining 24 are currently classified as unknown (WDFW 1998a). Lifecycle timing is illustrated in Table 16. Note that freshwater rearing presence of resident, fluvial, and ad fluvial bull trout may occur throughout the year.

Table 16 Lifecycle Timing of Coastal/Puget Sound Bull Trout



*Note: Freshwater rearing presence of resident, fluvial, and adfluvial bull trout may occur throughout the year.

Factors for Decline
Habitat degradation is one of the major threats to the existence of bull trout. The loss of riparian vegetation can result in an increase in water temperature and sedimentation. A decline in the recruitment of LWM can reduce channel/bank stability, a loss of instream cover, and a decrease in stream complexity. Passage barriers (such as dams, diversions, and culverts) can eliminate access to upper watershed spawning areas and isolated resident populations above these barriers may suffer a loss of genetic diversity. The introduction of brook trout (*S. fontinalis*) has also had a detrimental impact to bull trout. Not only do brook trout directly compete with bull trout for food and habitat resources, but they may also spawn with them to produce infertile hybrids.

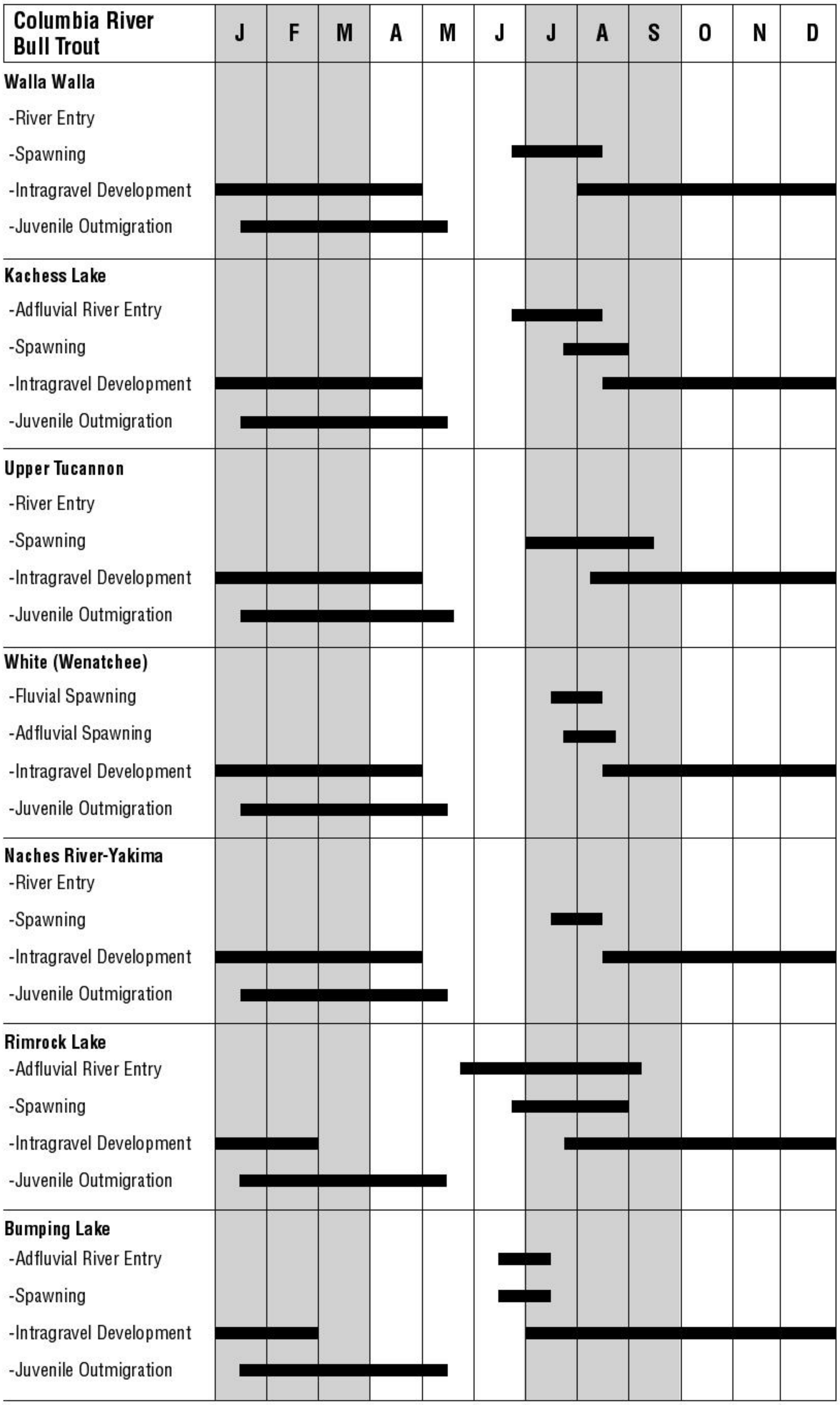
Critical Habitat
Critical habitat is currently not designated for bull trout in Washington.

3.2.5.2 Columbia River Bull Trout

Bull trout were officially listed as threatened for the Columbia River drainages in June 1998. USFWS is the lead regulatory agency for this listing under the ESA.

Distribution and Condition
Of the 51 known populations within the Columbia River ESU, nine are categorized as healthy, two are depressed, six are critical. The other 34 are unknown at this time (WDFW 1998). Lifecycle timing is shown in Table 17. Note that freshwater rearing presence of resident, fluvial, and ad fluvial bull trout may occur throughout the year.

Table 17 Lifecycle Timing of Columbia River Bull Trout



*Note: Freshwater rearing presence of resident, fluvial, and adfluvial bull trout may occur throughout the year.

Factors for Decline
Freshwater habitat degradation is one of the major threats to the existence of bull trout. The loss of riparian vegetation can result in an increase in water temperature and sedimentation. A decline in LWM can cause a reduction in channel/bank stability, a loss of in-stream cover, and a decrease of in-stream complexity. Thermal and passage barriers (such as dams, diversions, and culverts) can eliminate access to upper watershed spawning areas and can prevent migration completely, isolated resident populations above these barriers may suffer a loss of genetic diversity. The introduction of brook trout (*S. fontinalis*) has also had a detrimental impact to bull trout. Not only do brook trout directly compete with bull trout for food and space, but they also may produce infertile hybrids when spawning together.

Critical Habitat
Critical habitat is currently not designated for bull trout in Washington state.

3.2.6 Coho Salmon *(Oncorhynchus kisutch)*

Coho salmon are listed as candidate species under the jurisdiction of NMFS. Candidate species are not considered "listed" species and will not be covered under the Regional Program at this time. They are included in this Biological Review because of their presence within Washington state.

Life History -- Juvenile History
Coho salmon eggs incubate in the gravel from three to five months depending on the water temperature (Steelquist 1992). The Coho emerge as fry between February and June where they remain in fresh water for the next one to two years. They spread out into the available rearing space, some moving upstream but most moving downstream (Meehan 1991). Water velocity and the presence of other fish are important constraints on the habitat that can be used by fry, which often must remain in shallow fringe areas of pools and runs until they become large enough to compete successfully for favored feeding stations.

There does not appear to be any clear, regional pattern for either smolt out migration timing, or smolt size. Smolt outmigration timing and smolt size appear to respond to small-scale habitat variability. For example, juveniles residing in ponds or lakes often have different outmigration timing and are a different size than smolts residing in streams within the same basin (NMFS 1999). However, peak outmigration timing generally occurs in May through June of their second year (1+ aged fish). Coho smolts spend a short time (a few days to a month) in estuaries, where they complete the smoltification process.

Run Timing and Spawning
Most coho spend two or three years at sea, reaching lengths of up to 33 inches or more. In Washington, adult coho return from the ocean as early as August and begin spawning activities between October and early February. Coho generally spawn in the tributaries and headwater streams of large rivers, preferably in areas with low water velocities and small-sized gravel. Coho females are usually present on the spawning grounds for 11 days, while males may remain for 12 to 15 days (Wydoski and Whitney 1979).

Habitat Requirements
Coho salmon are found across a wider range of habitats than any other anadromous salmonids. Much like the cutthroat trout (*Oncorhynchus clarki*), they manage to survive in the most unlikely surroundings (such as urban/suburban ditchlines and chemically-impacted farmland creeks). Although they have a relatively high threshold to habitat degradation, their numbers continue to decline. This may be an indication that human-caused impacts are greater than this species' resiliency.

Coho spawn timing and habitat varies between sites. Spawning generally occurs between October and February in water temperatures between 4.4°and 9.4°C. Coho seek out areas with a substrate size between 0.5 to four inches in diameter. Spawning areas usually consist of shallow riffles/glides with a velocity up to 0.9m/sec (Reiser and Bjornn 1979). The average area of a coho redd is 30 square feet. Redds are usually located near LWM or overhead cover to provide hiding and holding areas. The young hatch in about eight weeks, and remain in the gravel for another four weeks. Prior to emergence, waters should be between 4.4°to 13°C and relatively free of fine sediments.

Coho spend up to 2 years rearing in freshwater. This dependence on the freshwater environment puts coho at a great risk from habitat degradation. Ideal habitats for rearing juveniles should provide protective cover in the form of LWM, boulders, deep pools, overhanging vegetation, and undercut banks. Summer water temperatures should not exceed 18.3°C. During the winter, coho seek out the refuge of off-channel habitat (wall-based channels, oxbows, side channels, etc.) to protect them from the high flows in the mainstem rivers (Everest and Chapman 1972).

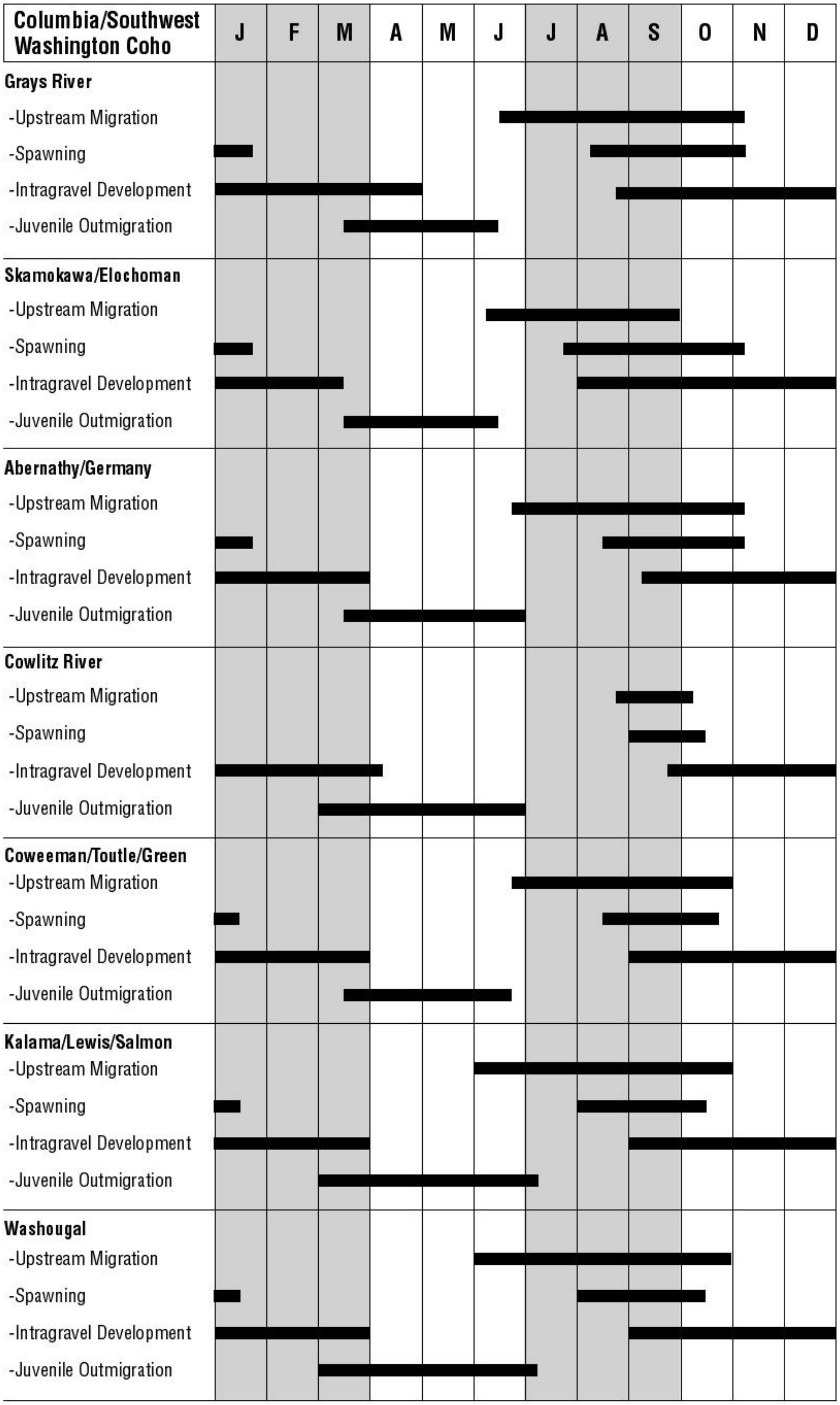
3.2.6.1 Lower Columbia River / Southwest Washington Coho Salmon
On July 25, 1995, NMFS determined that listing coho salmon was not warranted for the Lower Columbia River/Southwest Washington ESU. However, the ESU is designated as a candidate for listing due to concerns over specific risk factors. NMFS is the lead regulatory agency for this candidacy under the ESA.

Distribution and Condition
Coho occur along the Pacific coast from Monterey Bay, California, northward to Point Hope, Alaska. This species is also found in northeast Asia. Successful introductions have occurred in the Great Lakes. In Washington, coho juveniles and spawning adults are found in most streams of the upper and Lower Columbia River drainage, coastal drainages, and Puget Sound drainages.

The lower Columbia/southwest Washington population segment includes all naturally spawned populations of coho salmon from the Columbia River tributaries below the Klickitat River, as well as coastal drainages in southwest Washington between the Columbia River and Point Grenville. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 10,418 square miles in Oregon and Washington. The following Washington State counties lie partially or wholly within these basins: Clark, Cowlitz, Grays Harbor, Jefferson, Klickitat, Lewis, Mason, Pacific, Skamania, Thurston, and Wahkiakum.

The 1992 Washington SASSI classifies as depressed all 17 coho stocks within the Lower Columbia River Basin due to chronically low spawner escapement numbers (WDFW 1993). Lifecycle timing is shown in Table 18.

Table 18 Lifecycle Timing of Lower Columbia/Southwest Washington Coho



*Note: Freshwater rearing presence of resident, fluvial, and adfluvial bull trout may occur throughout the year.

Factors for Decline
Coho salmon juveniles spend a relatively long time in freshwater (up to two years or more). This dependence on the freshwater habitats can leave them very susceptible to habitat degradation. In the lower Columbia/southwest Washington ESU several natural and anthropogenic factors limit coho production. Historic and current logging practices have caused many adverse impacts to the aquatic environments: increased temperature and sedimentation; decreased LWM recruitment and riparian vegetation; and increased slope failures and fish passage problems.

The eruption of Mt. St. Helens severely damaged parts of the Cowlitz and Toutle River basins. Similarly, increased urbanization, diking, and industrial pollution have created a loss of overwintering and spawning habitats. High rates of sport and commercial harvest have also been attributed to the decline of the Lower Columbia River coho.

Critical Habitat
Critical habitat is currently not designated for coho salmon in Washington.

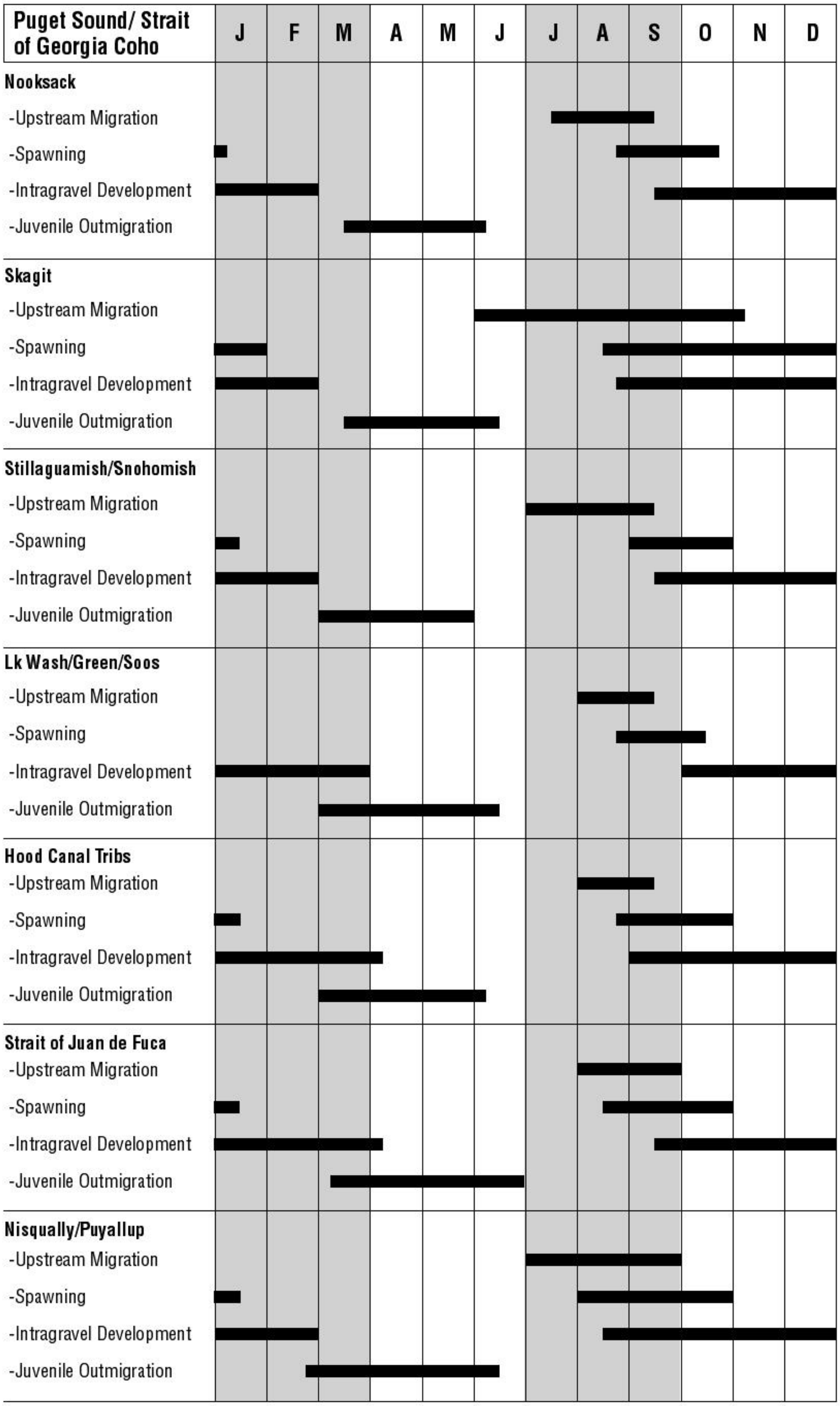
3.2.6.2 Puget Sound/Strait of Georgia Coho Salmon

On July 25, 1995, NMFS determined that listing coho salmon was not warranted for the Puget Sound/Strait of Georgia ESU. However, the ESU is currently designated as a candidate for listing due to concerns over specific risk factors. NMFS is the lead regulatory agency for this candidacy under the ESA.

Distribution and Condition
The ESU includes all naturally spawned populations of coho salmon from drainages of Puget Sound and Hood Canal, the eastern Olympic Peninsula (east of Salt Creek), and the Strait of Georgia from the eastern side of Vancouver Island and the British Columbia mainland (north to and including the Campbell and Powell Rivers), excluding the upper Fraser River above Hope. Major U.S. river basins containing spawning and rearing habitat for this ESU comprise approximately 13,821 square miles in Washington. The following counties lie partially or wholly within these basins: Clallam, Grays Harbor, Island, Jefferson, King, Kitsap, Kittitas, Lewis, Mason, Pierce, San Juan, Skagit, Snohomish, Thurston, and Whatcom. Lifecycle timing is shown in Table 19.

The 1992 Washington SASSI identifies the presence of 46 stocks within the Puget Sound/Strait of Georgia ESU. Twenty of those stocks are classified as healthy, 16 as depressed, one as critical (Discovery Bay Coho); nine are currently unknown.

Table 19 Lifecycle Timing of Puget Sound/Strait of Georgia Coho



Factors for Decline
There are a number of reasons for the continued decline of coho in the Puget Sound/Strait of Georgia ESU. Intense urbanization has decimated many of the historic coho rearing and spawning areas. Much of the potential freshwater production has also been lost due to flood control (diking), logging, hydropower, agriculture, road building, and other anthropogenic activities. Low STE from the gravel, habitat degradation, and poor water quality are the key factors for their decline. Harvest pressure, hatchery introductions, and interspecies competition have all contributed to the further decline of the coho populations in this region.

Critical Habitat
Critical habitat is currently not designated for coho salmon in Washington state.

3.2.7 Cutthroat Trout *(Oncorhynchus clarki)*

NMFS transferred jurisdiction for cutthroat trout to USFWS on April 21, 2000, for lead regulatory agency for listing under ESA. Cutthroat trout are currently a candidate species proposed to be listed as threatened under the ESA. They are included in this BR because of their presence within Washington State.

Life History
Coastal cutthroat trout (*O. clarki*) exhibit diverse patterns in life history and migration behaviors. Populations of coastal cutthroat trout show marked differences in their preferred rearing environments (river, lake or estuary); size and age at migration; timing of migrations; age at maturity; and frequency of repeat spawning. Four major life history patterns have been described for the subspecies: anadromous, fluvial, adfluvial, and non-migratory (resident) (ODFW website).

Resident fish occur in small headwater streams and exhibit little in-stream movement. Fluvial populations are fish that undergo in-river migrations between small spawning tributaries and main river sections downstream. Adfluvial populations migrate between spawning tributaries and lakes or reservoirs (ODFW website). Anadromous (sea run) populations migrate to the ocean (or estuary) in the spring, usually at age one to six, where they typically remain for up to one year. Coastal cutthroat trout populations with different life history patterns may be sympatric in the same river.

Sea-run cutthroat may produce young with any of the above life history patterns, and it is not known what triggers a fluvial, adfluvial, or resident fish to become anadromous. While freshwater forms of coastal cutthroat are widespread throughout this region, the anadromous form is in sharp decline.

Run Timing and Spawning
Cutthroat trout typically spawn in the spring or early summer, with sea-run cutthroat spawning occurring as early as late December (Wydoski and Whitney 1979). Sea-run cutthroat either spawn during the first winter or spring after their return or undergo a second ocean migration

before maturing and spawning in fresh water. Sea-run cutthroat appear to remain near shore, probably near the mouth of their natal river, during their marine occupancy.

Probably to avoid competition with larger salmonids, cutthroat trout typically lay their eggs upstream of steelhead spawning zones in very small (first and second order) tributaries. Egg production of females ranges from about 300 eggs from a 11.8 inches in length female to about 2,700 eggs from a 22 inches in length female. A typical redd is two feet long and one and a half feet wide; the redd is in seven inches of water in a riffle, with the eggs five to seven inches under coarse gravel about the size of a walnut (pea-sized at the level where eggs are laid) (Wydoski and Whitney 1979).

Habitat Requirements

Coastal cutthroat trout tend to spawn in very small (first and second order) tributaries. Young fry move into channel margins and backwater habitats during the first several weeks. During the winter, juvenile cutthroat trout use low velocity pools and side channels with complex habitat created by large woody material (ODFW website).

The timing for cutthroat trout to return to their natal streams has a genetic basis, but spawning usually occurs when water temperatures reach 6.1° to 17.2°C (Reiser and Bjornn 1979). The average area of a cutthroat redd is approximately four square feet, usually found in gravel from 0.25 inch up to three inches in diameter, depending on the size of the female (Reiser and Bjornn 1979). Cutthroat generally seek out spawning areas of shallow depths in velocities up to 0.72 meters/second.

3.2.7.1 Southwestern Washington/Lower Columbia River Coastal Cutthroat Trout

Southwestern Washington/Columbia River coastal cutthroat trout were proposed for listing as a threatened species on April 5, 1999. NMFS transferred jurisdiction to USFWS on April 21, 2000, for lead regulatory agency for listing under ESA. This ESU includes populations of coastal cutthroat trout in the Columbia River and its tributaries downstream from the Klickitat River, as well as populations in Washington coastal drainages from the Columbia River to Grays Harbor (inclusive) (USFWS website).

Distribution and Condition

Coastal cutthroat trout are distributed along the Pacific Coast from northern California's Eel River to Prince William Sound, Alaska. In Washington, coastal cutthroat trout extend to the crest of the Cascade Mountains and in British Columbia and Alaska to the crest of the Coast Range; their distribution rarely extends inland more than 100 miles. This geographical pattern corresponds closely to the distribution of the coastal rain forest belt in the Pacific Northwest (ODFW website).

Major river basins containing spawning and rearing habitat for this ESU comprise approximately 12,136 square miles in Oregon and Washington. The following Washington counties lie partially or wholly within these basins: Clark, Cowlitz, Grays Harbor, Jefferson, Klickitat, Lewis, Mason, Pacific, Skamania, Thurston, Wahkiakum, and Yakima (NMFS website). Lifecycle timing is shown in Table 20.

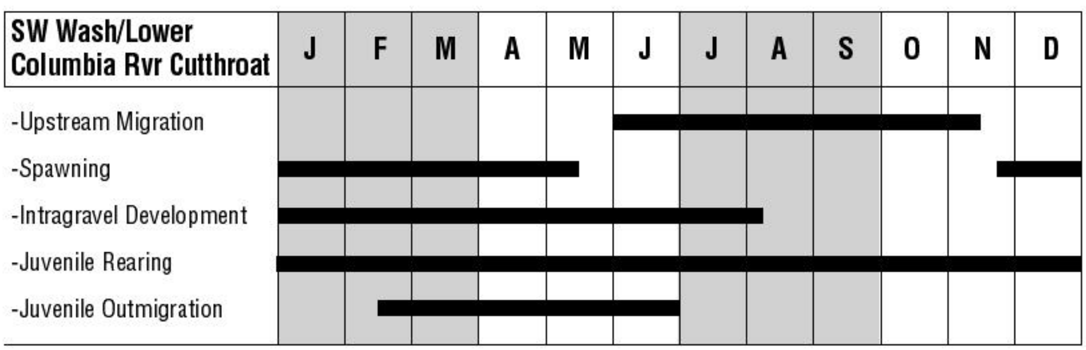
Factors for Decline
Severe habitat degradation throughout the Lower Columbia River area has contributed to dramatic declines in anadromous coastal cutthroat trout populations (NMFS 1999). Critical cutthroat trout habitat is often impacted by: logging (which causes sedimentation of fine spawning gravel and loss of shade over small spawning streams); grazing; road building; and land development activities that impact water quality and stream flows; and decrease habitat complexity. In addition, the introduction of non-native salmonids and over-harvest has had detrimental effects on the coastal cutthroat trout population.

Sea-run cutthroat are incidentally harvested in hatchery and other salmonid fisheries. Returns of both naturally and hatchery-produced sea-run cutthroat in almost all Lower Columbia River streams have been declining markedly for the last 10 to 15 years.

Anecdotal observations indicate that most resident, fluvial or adfluvial cutthroat populations remain relatively abundant, even in streams where the abundance of anadromous fish has sharply declined. This pattern suggests that sea-run populations are most impacted by problems that occur along migration corridors, in estuaries, or in near-shore environments. Life history characteristics make anadromous coastal cutthroat trout sensitive to disruptions in over-wintering freshwater habitat as well as in estuarine and near-shore environments (ODFW website).

Critical Habitat
Critical habitat is currently not designated for cutthroat trout in Washington State.

Table 20 Life Cycle Timing of Southwest Washington/Lower Columbia River Cutthroat



4.0 Baseline Habitat Data

Baseline habitat data is currently being compiled for salmonids in Washington. The Washington State Conservation Commission, in consultation with local government and treaty tribes, is developing limiting factors reports on habitat conditions in Water Resource Inventory Areas (WRIAs) throughout the state[4]. The intent of these *Habitat Limiting Factors* reports is to help local organizations collect data and identify gaps in existing information on factors affecting natural salmonid production. The reports may be considered the environmental baseline for salmonid habitat in Washington.

This habitat data collection began under Engrossed Substitute House Bill (ESHB) 2496, which was passed by the Washington State Legislature and signed into law in 1998. The resulting law was codified in Revised Code of Washington Chapter 77.85 RCW (Salmon Recovery). Its purpose is "to identify the limiting factors for salmonids," where "limiting factors" are defined as "conditions that limit the ability of habitat to fully sustain populations of salmon." The statute further clarifies the definition by stating, "These factors are primarily fish passage barriers and degraded estuarine areas, riparian corridors, stream channels, and wetlands." Implementation of RCW 77.85 does not constitute a full limiting factors analysis. It does, however, represent Best Available Science (BAS). Hatchery, hydroelectric, and harvest segments of identified limiting factors are covered in other forums.

The Legislature directed the Commission to form Technical Advisory Groups (TAGs) to write the reports. The TAGs consist of private, federal, state, tribal, and local government personnel with appropriate expertise. To date, the TAGs have completed several *Habitat Limiting Factors* reports, which are developed on a WRIA basis. Washington State contains 62 WRIAs; 26 reports are complete; 12 are currently underway; and 24 are not yet begun. The completed *Habitat Limiting Factors* reports are located in Appendix A of this BR. Appendix A is a separately bound volume.[5]

4.1 WRIA Based Data

For the *Habitat Limiting Factors reports,* each WRIA is subdivided into separate watersheds or sub-basins. Each chapter presents data on habitat-limiting factors for each watershed or sub-basin. Following are examples of limiting factors:

- Watershed characteristics and conditions (location, topography, climate, hydrology, geology and groundwater movement, soils and vegetation)
- Historic and current land use
- Access to spawning and rearing habitat
- Floodplains and channel conditions

[4] Water Resource Inventory Areas were established in the early 1970s by the state of Washington for the purpose of resource planning and management. A WRIA is essentially an administrative unit that closely follows watershed boundaries. There are 62 WRIAs in Washington State (WAC 173-500-040).
[5] Contact the Washington State Conservation Commission for full text copies of these reports. Maps included in the reports were created and will be updated by the Commission.

- Riparian conditions
- Water quality
- Exotic and opportunist species
- Biological processes
- Estuarine and nearshore habitat.

Table 21, summarizes the specific known habitat limiting factors in each WRIAs in Washington state (i.e., the environmental baseline). Baseline data includes such information as location, sub-basins, land use, zoning, nearshore habitat and forage fish, known and presumed distribution of aquatic species, barriers, structural elements, channel characteristics, water quality, in stream flow, riparian condition, watershed health and other data.

This WRIA-based data is drawn from the following sources:

- Formal habitat inventories or studies specifically directed at evaluating fish habitat.
- Other watershed data not specifically associated with fish habitat evaluation.
- Personal experiences and observations of watershed experts involved in the TAGs.

Few, if any, of the habitat data or observations meet the highest standard of peer review literature. However, they should nevertheless be considered presumptively valid because they are based on the experiences of the watershed experts actively working within these areas. Future peer review and research of data gaps will require additional watershed research or evaluation by the Commission.

4.2 Findings on Salmonid Habitat in Washington State

Although the data was scattered, and the specific habitat concerns differed among WRIAs and streams within the WRIAs, some common habitat findings emerge:

- Adjacent land management practices and direct actions within stream corridors have significantly altered natural stream ecological processes.
- Fine sediment (.85 mm) levels in stream gravels regularly exceed the <12% level identified as representing suitable spawning habitat (USFWS 1999).
- Lack of adequate LWM in streams, particularly larger key pieces needed to develop pools, log jams, and other habitat components important to salmonids.
- Lack of adequate pools, and large, deep pools important to rearing juvenile salmonids and supporting adult salmonids during their upstream migrations.
- Naturally high rates of channel constrictions, which further worsens the rate of streambank erosion and substrate instability due to loss of streambank and riparian integrity, and the alteration of natural hydrology.
- Loss of riparian function due to removal, or alteration, of natural riparian vegetation. This habitat loss affects water quality, lateral erosion, streambank stability, and in stream habitat conditions.

- Presence of a significant number of barriers, such as culverts, screens, water diversions, and dams. Barriers prevent unrestricted upstream and downstream access to juvenile and adult salmonids.
- Significant alterations to natural stream hydrology in streams where uplands have been heavily developed. The threat of similar impacts to streams experiencing current and future development growth.
- Physical alteration of the natural estuary has significantly impacted estuarine/marine function. . For example, bulkheads may cause poor water quality and significantly alter nearshore ecological function.

The *Habitat Limiting Factors* reports provide environmental baseline information that can, and should, be used to develop salmonid habitat protection and restoration strategies. The Regional Program supports these strategies by developing BMPs that avoid and minimize impacts to aquatic habitats due to routine road maintenance activities.

It is not the intent of this BR, nor the Regional Program, to duplicate the Commission's work, but to help make the *Habitat Limiting Factors* reports available to state and local governments' environmental and road maintenance staff. Additional habitat assessment data and habitat restorations are incorporated into the Commission's existing documents, and therefore are considered to be living documents. The Regional Program Element 8: Adaptive Management (through the Regional Forum) allows this material to be passed on to state and local road maintenance agencies for use at their discretion.

Appendix A. Summary of Habitat Limiting Factors Reports Please view in

(**Please view in Appendices section**)

5.0 Effects of the Action

This BR evaluates the Regional Program in context of Limit 10(ii) of the 4(d) Rule. This chapter provides the criteria used to evaluate the effects of the Regional Program. It also puts potential impacts of the Regional Program into a context, given the broad range of factors affecting listed species and their habitats in Washington state.

5.1 Criteria for this Biological Review

The evaluation criteria used in this BR is applied to 14 Environmentally Significant Units (ESUs) of threatened salmonids in Washington. An ESU is a "distinct" population of Pacific salmon, and hence treated as a species, under the ESA. The June 2000 4(d) rule for 14 ESUs of threatened salmonids proposes 13 limits on the prohibition against take of those species. The limits were developed for certain land and water management activities that NMFS determined will conserve habitat of threatened salmonids even though those activities might incidentally take individual listed fish. Road maintenance is one of those activities.

To make its determinations, NMFS evaluated whether the activities would allow the attainment and persistence of properly functioning conditions (PFC) for habitat. In its recent guidance, *The Habitat Approach*, NMFS defines PFC as the sustained presence of natural habitat-forming processes necessary for long-term survival and recovery of the species (NMFS 1999). PFC is a condition in which the processes that conserve the species—essential physical features that support spawning, incubation, rearing, feeding, sheltering, migration, and other behaviors—are perpetually present. Such features include adequate in stream flow, loose gravel for spawning, unimpeded fish passage, deep pools, and abundant LWM.

A variety of scientifically credible analytical frameworks exist for determining the effects of a project or program of activities on salmonids and their habitat. In assessing proposals to include programs within one of the 13 limits, NMFS will accept any scientifically credible analysis. NMFS has developed a default analytic methodology that the applicants for this Limit 10 proposal have adopted as the analytical model for this BR[6]. In its analytical model, NMFS uses a Matrix of Pathways and Indicators (MPI) framework. In the MPI framework, the pathways for determining the effect of an action are represented as six conceptual groupings *(e.g.*, water quality, channel condition) of 18 habitat condition indicators *(e.g.,* temperature, width/depth ratio). Indicator criteria are mostly numeric and indicate one of three levels of environmental baseline condition: properly functioning, at risk, and not properly functioning. The effect of an action upon each indicator is classified by whether it will restore, maintain, or degrade the indicator.[7]

---

[6] *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scal*e, NMFS 1996

[7] Although indicators used to assess PFC may entail instantaneous measurements, they are chosen using BAS to detect the health of underlying processes, not static characteristics. Science advances through time. This advance allows PFC indicators to be refined, new threats to be assessed, and species' status and trends to be better understood. River habitats are inherently dynamic, and the PFC concept recognizes that natural patterns of habitat.

The MPI provides a consistent, but geographically adaptable, framework for making effect determinations and examining the effects of a project or program of activities on the conservation of salmonid species. The pathways and indicators, as well as the ranges of their associated criteria, may be altered through the watershed analysis process. Regardless of the analytical method used, if a proposed action is likely to impair properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of impaired habitat toward PFC, it cannot be found consistent with conserving the species. If a program preserves existing habitat function levels, and allows natural progression towards PFC where habitat is impaired, NMFS may determine that it qualifies for inclusion under one of the 13 take limits in the June 2000 4(d) rule.

In the final 4(d) rule, NMFS defined the criteria for approval of a Road Maintenance program, defining PFC as it is defined above and identifying how NMFS will evaluate programs for meeting this biological standard. Chapter 6, Analysis of Effects, describes how road maintenance activities affect the functional condition of the pathways and indicators mentioned above. These effects are then compared with those anticipated under the proposed Regional Program to show how the *Guidelines* work to attain or maintain PFC.

5.2 Context of this Biological Review

To assess the extent to which the proposed Regional Program contributes to the conservation of threatened salmonids in Washington, the context in which the proposal is made must be clear. The existence and use of roads have degrading effects on the quantity and quality of salmonid habitat. Road maintenance practices can add to these effects, but can also help reduce or avoid these effects. More importantly, the contribution of historic and present road maintenance practices is minimal relative to the many other land-use practices that have shaped the present environmental baseline.

The existence and use of roads are a single factor among a myriad of causes of habitat degradation described earlier. Evaluating the extent to which road maintenance activities have contributed to the current status of threatened salmonids in Washington must then be made in the context of other actions. The scope of a project or program of activities seeking a 4(d) limit is important in effects analysis. Generally, the scope of a program may be such that only a portion of the habitat-forming processes in a watershed are affected by it.

While the effects of the existence and use of roads are but a subset of overall land-use effects, roadways do contribute to the following effects on PFC for salmonid habitat:

- Sediment and contaminant delivery to streams
- Altered hydrology by disrupting subsurface flows (affecting base flows and contributing to increased peak flows)
- Within riparian zones, reduced riparian structure (reducing shade, natural bank stability, delivery of LWM and leaf-litter sources, among other things).

---

disturbance will continue. Floods, landslides, windstorms, and fires all result in spatial and temporal variability in habitat characteristics, as do human activities. Unique physiographic and geologic features may cause PFC indicators to vary among landscapes. For example, aquatic habitats on timberlands in glacial mountain valleys are controlled by natural processes operating at different scales and rates than are habitats on low-elevation coastal rivers.

These conditions can degrade habitat by increasing fine sediment levels, reducing pool volumes, increasing channel width, and exacerbating seasonal temperature extremes.

In ESA terms, the mere presence and use of roads that are adjacent to, cross, or discharge to water can cause or contribute to habitat degradation. However, the effects of the existence and use of roads alone does not constitute the appropriate venue of inquiry for a BR of a Limit 10 submittal.

Instead, this review must examine a description of past and present road repair and maintenance practices. These practices include those activities taken to prevent a decline, lapse, or cessation in the use of structures and systems and include replacement of malfunctioning facilities. Some of these practices may adversely affect salmon on a short-term or temporary basis and still provide longer-term benefits. Other practices may have adversely affected salmonid habitat quality and quantity based on how they have been practiced in the past. Some examples include bridge sandblasting and painting, road resurfacing, installation of riprap, gabions, and rock walls to prevent streambank erosion, vehicle maintenance, installation and maintenance of new impervious surfaces, culvert replacement and repair, LWM removal, drainage system installation and maintenance, and diversion of surface and groundwater. Other examples include street cleaning, dust abatement, equipment cleanup, hazardous material release and cleanup, landscape maintenance and restoration, and pesticides and fertilizer applications.

However, maintenance practices also have the capacity to ameliorate or even avoid the effects of roads and road use. Some of these benefits include temporary sediment and erosion control measures, storm water control management, street sweeping, and fish barrier removal as part of culvert replacement work.

5.3 Factors Affecting Habitat

Many factors affect listed salmonid species and their habitats in Washington. The contribution of historic and current road maintenance practices is minimal relative to the many other land-use practices that have shaped the environmental baseline. The habitat-based factors affecting the decline of salmonid populations in Washington include, but are not limited to, the following[8]:

- Degradation of water quality and changes in natural hydrographs
- Disturbance or elimination of riparian habitat
- Degraded stream bank and channel conditions
- Barriers to fish passage including culverts, dams, and diversions.

Between 45% and 62% of Washington's estuarine habitats have been lost to diking, channelization, dredging and filling. The state has lost more than 30% of its original 1.35 million acres of wetlands. More than 90% of the wetlands in urban areas have been lost to

[8] For more information on the technical basis from which government agencies and landowners can approach habitat conservation issues see the ManTech report (Spence et al. 1996). It describes impacts of human activities on watershed and instream processes in context of habitat requirements of salmonid life stages. For background on strategies affecting aquatic resources in Washington state, see *Changing Our Water Ways: Trends in Washington's Water Systems*, (Washington State Department of Natural Resources 2000). An additional general resource for evaluating salmonid habitat in Washington is *Extinction is Not an Option: Statewide Strategy to Recovery Salmon* (State of Washington, Governor's Salmon Recovery Office November 1999).

development. It is estimated that one-third of Puget Sound's shoreline has been modified by human development, with 25% occurring in the inter-tidal zone. Some of the primary causes of lost salmonid habitat in urban areas are conversion of forest and agricultural lands, filling, diking, dredging, creation of impervious surfaces (parking lots, roofs, etc.), construction of bulkheads and docks, and introduction of contaminants and exotic species.

Salmon provide critical links in an entire food web. They transport energy and nutrients between the ocean, estuaries, and freshwater environments, even in death. Marine-derived nutrients delivered by anadromous salmon to Puget Sound rivers, the Washington Coast, and the Columbia River have decreased dramatically due to the many factors affecting salmonids. Researchers surmise this is due to the substantial loss of habitat and other human disturbances over the past several decades.

Today's growing population means increased pressure on the state's already diminished natural resources. Washington's current population of 5.8 million is expected to rise nearly two million by 2020, with most growth occurring in urban counties along Interstate 5.

5.3.1 Road Maintenance Practices

Road maintenance is a relatively small piece in the conservation puzzle as compared to all other contributing factors because it contributes only minimally to the environmental baseline for salmon habitat, a description of the baseline for statewide road conditions does not present the entire picture. Instead, the effects of the existence and use of roads must include a description of past and present road repair and maintenance practices. These practices include those activities taken to prevent a decline, lapse, or cessation in the use of structures and systems and includes replacement of malfunctioning facilities.   Some of these practices may adversely affect salmon on a short-term or temporary basis yet still provide long-term benefits. Other practices may have adversely affected salmonid habitat quality and quantity based on how they were practiced in the past.

However, maintenance practices also have the capacity to ameliorate, and even avoid the effects of roads and road use. For example, street sweeping and/or the application of temporary sediment and erosion control measures keeps sediment and pollutants from entering surface and groundwater.

5.3.2 Altered Hydrology

Increased land-use development, including construction of buildings and transportation infrastructure, increased the existing area of impervious surfaces. Addition of impervious surface affects the amount of water that seeps into the ground and washes into streams. It also affects how quickly water gets there. When land is covered with pavement or buildings, the area available for rainwater and snowmelt to seep into the ground and replenish the groundwater is reduced. The natural movement of water through the ground to usual discharge points such as springs and streams is altered. In many urban areas, it is virtually eliminated. Instead, natural flow is replaced by storm sewers or by more concentrated entrance points of water into the ground.

Changing the timing and amount of water runoff leads to too much water going directly into streams in the rainy months of winter instead of soaking into the ground. Consequently, there isn't enough water in the ground to slowly release into streams in the dry summer months. Too much water in winter can cause fish habitat to be scoured by unnaturally swift currents; not enough water in streams in the summer leads to water temperatures too high to support fish.

Attempts to mitigate for human safety and property losses caused by increased impervious surfaces and flooding—dikes, stormwater retention ponds and other structural solutions—caused widespread environmental problems. For example, levees along rivers have all but eliminated connectivity between rivers and remaining off-channel waters, and increased the speed and volume of run-off.

Studies show that when impervious surfaces, such as pavement and buildings, cover between five to eight percent of an urban watershed, despite stormwater controls, the health of streams and the fish in them declines. In the south Puget Sound area, most urban watersheds are 20 to 40 % covered with hard surfaces, altering stream flows, water temperatures, and in-stream habitat for everything from insects to fish.

Stream functions are also affected by diversions and impoundments of rivers. Dams and hydropower operations have modified the level, timing, frequency and duration of stream flows. Today, there are more than 1,000 dams obstructing the flow of water in Washington. They have blocked the movement of fish both upstream and downstream, dewatered stream segments below dams, caused loss of upstream habitat, altered stream temperatures and nutrient composition, decreased oxygen levels, and increased predation in reservoirs. Smolts and juvenile fish migrating downstream through the reservoirs encounter slower moving water, increasing the time it takes for them to reach the ocean, thereby increasing their chances of dying from predation and disease. The fish may also be exposed to gas super-saturation from water passing over the spillways, causing "gas bubble disease".

Water storage, withdrawal, conveyance, and diversions for municipal, industrial and agricultural purposes have resulted in some streams being so over-appropriated that they are dry streambeds during the low flow period in summer. In many other streams, flows are reduced well below natural flow levels. Over-appropriation conditions occurring in many streams and rivers used by salmonids can be found in at least 16 watersheds throughout the state, representing about a quarter of the state's basins. Sixty-five percent of the state's human population resides in these 16 basins. Over-appropriation means more water is being withdrawn from rivers and streams in those watersheds, especially in late summer and early fall, when flows are naturally low and when fish need water for migration, spawning or rearing. In some cases, flows that are too low can provide insufficient spawning areas to accommodate all returning adult fish. Flows that are depressed below natural low flows generally cause fish production to decline by reducing the total amount of habitat and food sources available in the stream. Low summer flows are also associated with higher water temperatures and higher concentrations of pollutants, which can be debilitating or even lethal to fish.

The modification of natural flow regimes has also changed fish community structures and depleted the flows necessary for flushing of sediment from spawning gravels, gravel recruitment and LWM transport.

5.3.3 Fish Barriers

Anadromous salmonids need access to spawning and rearing habitat, including unimpeded migration to and from the ocean. Unnatural physical barriers interrupt adult and juvenile salmonid passage in many streams, reducing productivity and extirpating some populations. Barriers may also cause poor water quality (such as elevated temperature or low dissolved oxygen levels) and unnatural sediment deposition. Impaired fish access is one of the more significant factors limiting salmonid production in many watersheds.

Several kinds of built structures block fish passage. Dams, culverts, tide gates, dikes and other in stream structures are barriers to fish. WSDOT and WDFW estimate that at least 80,000 miles of public roads are constructed in Washington, not including roads under private ownership (railroads, forest industry, agriculture, etc). These roads have created a minimum of 2,400 human-made barriers at road crossings, blocking fish access to an estimated 3,000 miles of freshwater spawning and rearing habitat.

Unscreened or inadequately screened surface water diversions, whether associated with a physical barrier or not, are another source of salmonid mortality or injury. This fish loss is a result of diversions that are unscreened, have screen mesh openings too large to exclude small fish, have approach velocities that are too high. If the fish are unable to locate a bypass to a blocked waterbody, they become exhausted and are swept against the screen, resulting in injury or death. Recent inventories of unscreened or inadequately screened diversions in the Snake, Yakima and mainstem Columbia rivers show that only 25 to 40% of diversions are adequately screened to protect salmonid fry.

5.3.4 Water Quality

Anadromous salmonids require clean, cool, well-oxygenated water in adequate quantity to survive rearing and migration periods both before spawning and after juveniles emerge from the spawning redds. Temperature and flow affect salmonid eggs during incubation and hatching.

The presence of adequate water quantity and quality during late summer are critical factors in controlling disease epidemics. As water quantity and quality diminish, and freshwater habitat becomes more degraded, increased physiological stress and physical injury in migrating juvenile salmonids increase the susceptibility of migrating salmon to pathogens and cause bacterial kidney disease (BKD) to come out of remission.

Water quality in urbanized streams is highly degraded. Nearly 700 waterbodies in Washington do not meet water quality or sediment standards. While the list represents only about two percent of the State’s waters, most estuaries and river systems in Washington are on the list, including those important for salmon. Bacteria, temperature, toxics, sediment, dissolved oxygen and acidity are the most common water quality criteria exceeding standards: all except bacteria are critical for survival of aquatic species. Most of the pollution comes from point sources that enter the waters from commercial, industrial, and municipal discharges and nonpoint sources generally caused by land-use activities.

5.3.5 Habitat

From high mountain streams to coastal shorelines, Washington's varied landscapes provide diverse aquatic habitats. Complex streams with good ratios of riffles and pools provide productive spawning habitats, as well as juvenile rearing areas in eddies and off-channel areas. The fresh and salt water mixing areas and cover found in estuarine areas are critical for both juvenile and adult salmonids. The ability of streams, estuaries, and their adjacent landscapes to provide these, and other essential functions has been reduced throughout the range of salmonids.

Since the arrival of non-native American settlers in the early 1800s, at least 50 % and as much as 90 % of riparian habitat in Washington has been lost or extensively modified (NMFS 1998). The loss of riparian vegetation and overall stream complexity has reduced many stream's buffering capacity–their ability to withstand high and low water events, maintain cool water temperatures, retain deep pools, and retain LWM.

The degree of spatial and temporal connectivity between and within watersheds is an important consideration in maintaining aquatic riparian ecosystem functions. Loss of this connectivity and complexity has contributed to the decline of salmonids. In Washington, the number of large, deep pools in National Forest streams has decreased by as much as 58% due to sedimentation and loss of pool-forming structures such as boulders and LWM. Increased sedimentation results in the loss of channel complexity, pool habitat, suitable gravel substrate, and LWM.

Salmonid species in forested ecosystems have evolved in streams in which LWM plays a major role in forming in-channel and off-channel habitats, providing cover, influencing the sediment process, and trapping nutrients. Forest riparian corridors provide critical functions, including shade, supply of logs or LWM, sediment filtering and bank stability. Other riparian features (e.g., reduction of floodwaters and off-channel habitat) are also important to both forest and aquatic systems.

Habitat modifying activities such as road building, timber harvest near streams or on steep or unstable areas, and the application of chemicals have damaged fish habitat and water quality. Stream surveys conducted by federal agencies show that habitat in forested areas of Washington is fair to poor. The most profound impacts include: increased stream temperature; diminished opportunities for LWM recruitment; alteration of groundwater and surface water flows (increased runoff and reduced percolation of rain and snowmelt into the ground); and degradation or loss of riparian habitats. Among many other things, forest practices also result in loss or degradation of spawning and rearing habitats.

In addition to the threat to salmon from ongoing forest practices over the last 30 years, more than 2.3 million acres (or nearly 10% of the state's forest lands) have been converted to other uses, such as roads, cities, farms and rural development. The loss of forests contributes to elimination and degradation of habitat for fish, and diminished water quality and quantity in streams and groundwater aquifers.

The extensive modification of freshwater salmonid habitat contributes to the adverse effects of drought, fire, and floods. Drought conditions can create both physical and thermal blocks to migrations. Low water conditions can also reduce salmon spawning success, and lead to high mortality as they emerge from the spawning gravel. Low stream flows and higher water temperatures caused by drought can exacerbate predation, stress, and disease. Upland and riparian habitat alteration can increase the adverse effects of fire in both forest and range habitats. Healthy riparian areas can withstand the effects of fire, but altered habitats can increase the incidence of fire as well as intensify its adverse effects on LWM recruitment, shade and soil stability.

Sand and gravel mining for road construction and industrial and urban development often occurs either in streams or adjacent flood plains. Sand and gravel operations, which include dewatering, extraction of the sand and gravel, washing and processing, degrade channel conditions creating wider and more shallow channels, reduce streamflow and lower ground water levels, eliminate gravel needed for spawning, and add sediment and minerals to streams.

Sometimes human impacts and natural events combine to change the flow of a river. The natural course of a river includes its floodplain. In what is known as avulsion, a surface mine pit located in a floodplain may suddenly reroute a river during a flood, "capturing" the river. Gravel spawning beds or other habitat in an abandoned channel become unavailable to fish. Gravel from upstream gradually fills the breached mine pit instead of getting washed downstream to replenish gravel bars. The river becomes less stable and less hospitable to salmon. When the east fork of the Lewis River was captured in 1995, it abandoned 1,700 feet of gravel spawning beds, and when captured again in 1996 it abandoned another 3,200 feet.

Washington has more than 3,000 miles of marine and estuarine shoreline. When these shorelines are altered by bulkheads, docks, piers, dredging and filling, intertidal and nearshore habitat is affected or lost, causing significant stress on the salmon that rely on these habitats. Adverse effects of these shoreline modifications include loss of riparian vegetation and a vast food source, shading of the nearshore aquatic zone, loss of silt that is carried along by currents to replenish beaches and nearshore habitat, and an increase in attractive refugia for piscivorous birds and fish. Development of the shoreline over the past 100 years has created a landscape that is dramatically different from what the first settlers found. Up to 52% of the central Puget Sound shoreline and about 35% of the shorelines of Whidbey Island, Hood Canal, and south Puget Sound have been changed or eradicated.

Since the days of United States expansion into the Pacific Northwest, marine shipping has played a key role in the Northwest economy, and ports are the critical hub of this waterborne trade. Dredging, filling, and other alterations have degraded and eradicated shallow estuarine habitat critical to the rearing needs of juvenile salmonids. Dredging the bottom of bays and rivers continues to displace plants and animals living there and stirs up contaminated sediment. Dumping dredged materials elsewhere in the water smothers habitat. Today, an average of 50% of the original wetland habitat in Puget Sound's major bays has been destroyed. Bays near urban centers such as Tacoma and Seattle have less than five percent of their natural inter-tidal habitat left.

5.3.6 Harvest

Since the late nineteenth century, fishing has contributed to the decline in salmon abundance. Salmon are harvested in tribal, commercial and recreational fisheries throughout Washington, with harvest rates reaching 50 to 60% of the salmon populations. Salmon are also taken for artificial production, supplementation, and broodstock collection activities, as well as for research purposes. Harvest restrictions have been used for many decades to reduce impacts, and to increase the number of adults escaping to spawning grounds. However, because various salmon populations mix together, harvest rates targeting abundant populations have disproportionately affected weaker stocks. Harvest has also altered species size, age structure, and migration timing for both smolts and adults. Finally, harvest can alter the structure of stream ecosystems by reducing the contribution of marine-derived nutrients from spawned adult salmon.

5.3.7 Hatcheries

Artificial production in hatcheries has been used for many purposes during the past 100 years. Hatcheries initially were used to augment the fishery, later to mitigate for habitat destruction by development activities, and more recently to supplement natural production and conserve salmon.

The early hatchery programs simplified and controlled salmon production systems. To offset declining wild fish runs, large quantities of eggs were collected, hatched, and the fry then transplanted into areas where fish were declining, or into bodies of water to increase catch.

Hatchery production was assumed to be additive to natural production with no impact on natural populations. Freshwater production was limited by spawning habitats and hatcheries were conceived as a means to augment natural production. Substantial hatchery efforts were developed to mitigate impacts from construction of hydropower projects and water diversions. However, several scientific reviews recently concluded that historic hatchery practices have had adverse effects on natural salmon populations. Competition, genetic introgression, and disease transmission resulting from hatchery introductions may significantly reduce the production and survival of native, naturally spawning salmon. Furthermore, collection of native salmon for hatchery broodstock purposes may result in additional negative impacts to small or dwindling populations.

5.3.8 Aquatic Nuisance Species

Aquatic nuisance species are plants and animals that threaten native aquatic life and habitat. They are introduced primarily through shipping, aquaculture, research, and aquaria industries. Several aquatic nuisance species currently pose a threat, such as *Spartina* (a cordgrass), zebra mussel, Chinese mitten crab, European green crab, and Eurasian watermilfoil. These plants and animals are not native to Washington's waterways and therefore have few or no predators. In a new environment, without checks and balances, their populations proliferate. As a result, these unwanted residents severely alter the ecological relationships in streams, lakes, estuaries and marine environments.

Aquatic nuisance species may out-compete native vegetation, resulting in a loss of biodiversity. In addition, these species severely alter or eliminate native habitat by elevating water temperatures, removing phytoplankton and zooplankton from fresh waters, reducing dissolved oxygen levels, changing pH, providing hiding places for prey species, and impacting spawning beds by colonizing areas where no native vegetation existed.

The noxious weed Spartina now occupies more than 6,000 acres in Washington and is successfully displacing native eelgrass in many areas along the coast. Eelgrass provides important habitat for the rearing of juvenile salmonids. In the Chehalis River, parrotfeather, another invasive weed, is colonizing the sloughs and backwaters of the system. Because parrotfeather alters water chemistry, these sloughs are becoming lost as rearing areas for juvenile salmon. In 1998, an expedition looked in Puget Sound for non-native species, and discovered more than 52 invasive species.

5.3.9 Regulatory Factors

Although many laws directly or indirectly mandate protection or restoration of salmonids and their habitats, the troubling status of these fish indicates that existing regulatory framework and implementing agencies may be unable to protect salmon populations and their ecosystems. Some of the failures may be due to the complexity and difficulty in addressing ecosystems; interconnections may be either ignored or poorly understood. Other failures may be due to the lack of enforceability, coordination, comprehensiveness, resources for implementation, data and scientific information, and public support.

In *Changing our Water Ways* and *Extinction is Not an Option: Statewide Strategy to Recovery Salmon,* the Washington Department of Natural Resources and the Governor's Joint Natural Resources Cabinet make it clear that efforts to resolve resource problems in the past have not ameliorated the cumulative effects of dams, agricultural practices, urban development, and industrial activity. Existing policies and programs are not sufficient to address current environmental challenges. Washington's aquatic habitat has been heavily altered or is so impaired it no longer supports salmonids the way it used to. Populations of many aquatic animals, including listed salmon, are in serious decline. In many places water quality is poor and riparian structure and function has been significantly altered from historical conditions.

In its listing decisions, NMFS concluded that not all of the biological requirements of the species within the action area are being met under current conditions, based on the best available information on the status of the affected species; information regarding population status, trends, and genetics; and the environmental baseline within the action area. Significant improvement in habitat conditions over those currently available under the environmental baseline is needed to meet the biological requirements for survival and recovery of these species. NMFS also concluded that further degradation of these conditions could have a significant impact due to the amount of risk they presently face under the environmental baseline [64 Federal Register 14307 at 14318-14319 (March 1999)].

6.0 Analysis of Effects

Road maintenance impacts to habitat are a relatively small factor in the overall balance between development and salmonid habitat recovery. Both positive and negative impacts of road maintenance on habitat are limited geographically by the physical constraints of the ROW. Effects are further constrained by the limited scope of activities that fall within the definition of maintenance.

Although small in scope relative to the many factors contributing to habitat conditions, road maintenance can contribute to conservation. Road maintenance is a form of mitigation for the original construction of the roadway. By implementing the Regional Program, road maintenance organizations can significantly contribute to PFC for aquatic species.

6.1 Road Maintenance

Road maintenance prevents the collapse, decline, or cessation in use of the ROW structure. It reduces or eliminates impacts from age as well as vehicle use and road wear. Given the critical nature of operating the transportation system, maintenance of the ROW structure is not optional and accomplishes 3 primary objectives

- Safety of the traveling public
- Preservation of infrastructure
- Mitigation of environmental impacts associated with initial construction and ongoing existence of the roadway.

The Regional Program achieves dual goals of operating a transportation system while conserving aquatic habitat conditions. Road maintenance activities prevent pollutants and sediment entrapped on the road surface and in stormwater facilities from entering waterbodies or ground water. They maintain proper functioning of facilities so that infrastructure performs as designed to reduce or remove pollution and control flow velocities. Proper maintenance of culverts is critical to fish passage. Road maintenance also reduces catastrophic system failure, which can be devastating to habitat as well as the ROW structure.

The *Guidelines* includes a set of conservation outcomes for each of 15 maintenance categories. To illustrate how maintenance activities contribute to conservation, clear examples can be found in the categories involving the roadway drainage system. Performing maintenance work of this kind, in accordance with the *Guidelines*, contributes to conservation as follows:

- Street sweeping reduces sediment from entering storm drains and waterways.
- Maintaining and cleaning enclosed drainage systems allows this infrastructure to function properly by trapping sediment and other pollutants. It also controls flow volumes and velocities.

- Cleaning and maintaining oil/water separators minimizes the likelihood of petroleum contaminants reaching habitat areas.
- Maintaining and cleaning retention/detention basins and connector ditches ensures that these systems function properly. This maintenance, like that for enclosed systems, traps sediment and other pollutants and controls flow volumes and velocities.
- Repairing and restoring retention/detention facility storage capacity regulates flow volumes and velocities.
- Mowing biofiltration swales ensures they continue to function properly, filtering pollutants discharging to surface or ground water.
- Cleaning water quality vaults ensures they continue to trap and contain sediment and other pollutants.
- Culvert repair and rehabilitation prevents collapse and perched culverts or other fish passage blockages. It also improves streambed habitat within the ROW.

Each maintenance category within the Regional Program has activities that contribute to conservation outcomes for that category.

6.2 Conservation Outcomes of the Regional Program

The Regional Program was designed to achieve conservation outcomes during the course of road maintenance work. Lists of specific conservation outcomes for each maintenance category are contained in the *Guidelines* in Program Element 10, BMPs and Conservation Outcomes. In a general sense, conservation outcomes of the Regional Program fall into the following categories:

- Sediment collection
- Worksite pollutant containment
- Blockage removal
- Restoration of flow velocities/volumes
- Removal of fish passage barriers
- Revegetation
- Infiltration
- Prevention of utility leaks
- Addressing chronic maintenance problems.

6.2.1 Sediment Collection

As discussed, routine maintenance of ROW structure improves water quality by containing and removing sediment and other pollutants before they reach aquatic habitat. The ROW structure itself traps sediment, other pollutants, and debris before it enters watercourses, streams or waterbodies. Containment of sediment/pollutants maintains or restores the sediment collection process by removing sediments from many collection points in the drainage system: catch basins, maintenance holes, retention/detention facilities, pipes, inlets, vaults, and other types of pollutant collection/separation facilities. Proper maintenance of the ROW structure also protects against collapse or failure of the structure, which could result in significant sediment releases to aquatic habitat.

The *Guidelines* articulate conservation objectives and outcomes associated with the sediment collection process and maintenance of the drainage system. Timely removal of sediments from collection points, as well as repair of broken or dysfunctional drainage system features, ensures the system will function properly. BMPs avoid and minimize the potential for sediment release to downgrade habitat during maintenance operations.

6.2.2 Worksite Pollutant Containment

Many BMPs in Program Element 10, and described in detail in Part 2 of the *Guidelines*, involve containment of sediment and other potential pollutants at the worksite. The purpose of this kind of BMP is to reduce worksite pollutant runoff to watercourses, streams and/or waterbodies. Similar to collection and removal of sediment and other pollutants from the ROW structure, containing loose soil, sediment, and other pollutants on the worksite reduces the amount of sediment (and other pollutants) that can reach aquatic habitat. A critical component of worksite pollutant containment in the Regional Program is monitoring implementation of BMPs after a maintenance activity has been completed to evaluate whether the BMPs function properly.

6.2.3 Blockage Removal

One conservation goal specified in the Regional Program is removal of drainage system blockages. Removal of blockages reduces the potential for sediment and debris to adversely impact fish habitat. Removing blockages or plugs in the drainage system reduces turbidity and offsite erosion. It also reduces the likelihood of system failure, which can have significant adverse habitat impacts. BMPs used during this type of work achieve the same objectives as those discussed in Sediment Collection and Worksite Pollutant Containment above.

Sometimes blockages occur directly in watercourses and streams, creating a safety hazard to roads or bridges, as well as a significant hazard to aquatic habitat. Such blockages can lead to catastrophic ROW structure failure, which can have severe adverse habitat impacts. Blockages in watercourses and streams also impede flows, which can adversely affect flow volumes and velocities. As emphasized in the *Guidelines*, blockage removal in watercourses or streams must be done in accordance with federal, state, and local regulations and permit requirements.

6.2.4 Restoration of Flow Velocities/Volumes

In addition to addressing sediment and pollutant impacts, maintenance of the ROW structure in accordance with the Regional Program maintains or restores flow velocities and volumes. Regulating velocities and volumes at discharge points can help establish (or re-establish) flows required for healthy aquatic life and habitat. This important conservation outcome is clearly spelled out in a number of maintenance categories involving drainage system maintenance. Flow velocities and volumes are addressed in the Regional Program by requiring appropriate system design for system repair or replacement, maintenance of existing systems, and removal of sediment or blockages.

6.2.5 Removal of Fish Passage Barriers

When performing stream crossing maintenance activities, one of the conservation outcomes prescribed in the *Guidelines* is removal of fish passage barriers. An important BMP related to fish passage work is the requirement to adhere to all federal, state, and local permit and regulatory requirements.

6.2.6 Revegetation

Revegetation is an important component of Program Element 10. The *Guidelines* specify the need for revegetation of disturbed areas to reduce erosion and sediment transport. Revegetation provides biofiltration, shading, and bank stabilization in riparian areas. It also promotes macroinvertebrate population growth. The nutrient process is maintained or restored by revegetating after land disturbance to hold sediment and to retain nutrients.

In addition to revegetation, the maintenance category for vegetation management achieves the following conservation outcomes:

- Improve drainage by reducing erosion
- Reduce the spread of noxious weeds and undesirable vegetation
- Limit erosion
- Increase bio-filtration
- Lower herbicide use
- Provide shading/reduce water temperature
- Provide habitat for macro invertebrates
- Provide LWM

6.2.7 Infiltration

The *Guidelines* specify the need to maximize opportunities for increased infiltration and biofiltration. Placing gravel on the edge of the roadway can enhance infiltration and biofiltration. Cleaning and maintaining roadway shoulders improves sheet flow and infiltration. BMPs for open drainage system maintenance, such as grass lined ditches, also encourage infiltration and biofiltration.

6.2.8 Prevention of Utility Leaks

An important conservation outcome associated with the maintenance of water and sewer systems is the repair or replacement of breaks and leaks. If not maintained, water or sewer systems breaks, leaks, or malfunctions, can cause increased flow volumes and velocities, severe erosion, and introduction of pollutants, such as sewage and chlorine, to aquatic habitat.

6.2.9 Addressing Chronic Maintenance Problems

The Regional Program recognizes that chronic road maintenance problems frequently create chronic problems for aquatic habitat. One of the conservation goals of the program is to reduce the number of chronic maintenance problems that contribute to habitat degradation. Where feasible, this will be done as part of Regional Program implementation. Unfortunately, permanent repair of such chronic repair areas is usually beyond the scope of maintenance as defined in the Regional Program. To address this problem, the Regional Program commits implementing agencies to refer chronic maintenance and habitat problems to agency-specific capital improvement programs.

6.3 Regional Program BMPs

This section of the BR evaluates the application of BMPs to road maintenance work to determine whether the Regional Program contributes to PFC. Section 6.4 evaluates the remaining program elements (1 through 9) to assess whether or not potential adverse impacts are adequately addressed through avoidance, minimization, and adaptive management.

The Regional Program directly contributes to conservation. The Regional Program BMPs, Program Element 10 and Part 2 of the *Guidelines*, are the most obvious means of directly influencing the way maintenance work is conducted in the field. In addition to the BMPs, the remaining 9 program elements provide a network of policies and practices that avoid and minimize potential adverse impacts. Integration of the 10 program elements also fosters improvements to the Regional Program over time through adaptive management.

The goals of the BMPs are to avoid and minimize potential adverse impacts of maintenance activities, and to achieve prescribed conservation outcomes during the course of maintenance work. To achieve these goals, an outcome-based approach is used. This approach helps to attain the desired conservation outcomes, in spite of various conditions in the field.

6.3.1 Outcome – Based BMPs

Conditions vary dramatically from site to site based on many factors:

- Soils/geological conditions
- Stream/surface water hydrology
- Groundwater conditions
- Presence of utility lines or structures
- Vegetation
- Resource availability
- Regulatory requirements (i.e. permit requirements)
- Legal Requirements (such as safety standards, regulations)
- Terrain
- Space available in ROW.

The menu of BMP options provided in the Regional Program allows road maintenance staff the flexibility to select the most efficient BMPs for each site. Using the outcome-based approach has a number of other important advantages:

- Positive conservation outcomes far outweigh negative impacts
- Negative impacts, if any, are short term
- End result of maintenance is an increase in habitat function

6.3.2 Permit Compliance as a BMP

An important component of Program Element 10 is compliance with environmental permits. Maintenance activities that involve in-water work must comply with seasonal construction restrictions that minimize impacts to salmonids. Typically, such work requires the issuance of a Hydraulic Project Approval permit (HPA) from the WDFW. In-water work restrictions are typically included in HPAs. In such instances, the maintenance activity must comply with the HPA conditions. Program Element 10 requires any agency to obtain an HPA from WDFW for applicable in-water work.

Each HPA is specific to a watercourse, stating the exact location of the work site, and usually consists of general, technical, and special provisions.

During actual in-water work, agencies are required to monitor the work to assure compliance with the Regional Program BMP outcomes including HPA provisions. Two general provisions of an HPA often require the notification of Area Habitat Biologist (AHB).

- Requires the permittee to contact AHB at least 2 to 3 days prior to project start date.
- AHB shall be contacted at least 24 hours before project completion for final field inspection of the site with the permittee.

If the desired outcome cannot be met, usually a provision of the HPA requires the permittee to cease work and notify the AHB of the change conditions. Either the HPA is terminated or modified to reflect the agreed upon correction.

In-water activities authorized by the Army Corps of Engineers (e.g. §404 permits) or funded by discretionary federal grants do not fall within the Regional Program and will not be covered by the 4(d) limit (NMFS) or a reduction or elimination of the prohibition on take of threatened species (USFWS). Instead such activities will comply with the ESA through consultation under ESA §7(a)(2).

6.3.3 Effects Analysis

Determining the effects of maintenance activities on ESA-listed salmonids is done indirectly, using the baseline indicators. Baseline indicators are a set of physical and biotic parameters that can be used to diagnose the relative health of salmonid-bearing fresh waters. In many cases, not all indicators will be applicable to a given category.

NMFS and USFWS both use their own versions of Matrix of Pathways and Indicators (MPI) or baseline indicators to summarize existing conditions within Washington State watersheds, and then to determine the effect of a proposed activity by evaluating the effect the work will have on the indicators. These matrixes were developed during consultation with the U.S. Forest Service (USFS). A matrix showing the baseline indicator levels for salmonids is contained in Appendix B of this document (Table B-1).

The baseline indicator matrices are not entirely applicable to existing roads, which unlike USFS activities, are not broad-based actions occurring at a watershed scale. Existing road structures are linear and tend to have limited point impacts rather than landscape-sized impacts. Given the linear nature of road maintenance activities, the USFWS and NMFS matrixes were combined.

Road maintenance practices affect habitat and salmonids differently depending on proximity to habitat and type of activity conducted. Tables 22-24 are organized by proximity, classification and components. Proximity is divided into three categories and refers to the distance a given activity is from the watercourse or stream. All those indicators that will be affected within the action area will be analyzed by the following categories:

1) greater than or equal to 300 feet from the watercourse or stream
2) adjacent to or above (within 300 feet) the watercourse or stream and
3) in the watercourse or stream.

Distance was determined based on the level of impact associated with the given activity and the proximity of the stream. Classification refers to the general type of maintenance activity, such as, Earth/Surface work, hydraulic modification, vegetation modification, paving/concrete, structure work and chemical. A component refers to the tasks completed within the general classification scheme. Components may include, but are not limited to, clearing, drilling, excavating, filling, culvert cleaning, culvert replacement, long and short term vegetation removal, planting vegetation, maintenance of existing road surfaces, painting, bridge debris removal, and the use of uncured concrete.

The selection of the appropriate indicators for a given category is based on the road maintenance work classification. Because this BR is not site specific, it is assumed worst-case scenario (salmonid species are likely to be present in the system). This assumption allows the most protective measures to apply to conserve the species.

6.3.4 Assessment Documents

The tables contained in this section are visual aids showing the possible effects of road maintenance activities without implementation of the Regional Program, compared with the effects of road maintenance work done in compliance with the Regional Program. No site-specific quantitative relationships are expressed or implied in the tables.

Table 22 outlines the Regional Program's Maintenance Activities. This shows the relationships common to the above-mentioned classifications and components evaluated within the BR. For example, common components of the Roadway Surface Maintenance Activity may include, but are not limited to: clearing, drilling, excavating, filling, grading, grubbing, cleaning, grinding, cutting; addition of impervious surface; maintenance of existing surface; heavy equipment present; fuel and industrial fluids present; painting; and uncured concrete, hot asphalt or hot tar used.

Table 23 and 24 uses the baseline indicators (Table B-1) developed by NMFS and USFWS. Tables 23 and 24, using the baseline indicators, evaluate the classifications and components based on proximity to the watercourse or stream. These tables take into account the various road maintenance activities performed by maintenance crews. The effect categories used in the tables are:

- (+) Likely to Restore baseline indicator
- (N) Not Likely to Adversely Affect
- (-) Likely to Degrade baseline indicator and
- (U) Unknown effect.

Following are examples of how the effect categories were assigned. These examples are not listed in entirety, but provide insight as to why a particular effect category was assigned.

Assignments of a Likely to Restore baseline indicator (+) may include, but is not limited to, the following:

- replacement culverts are designed in accordance with WDFW standards,
- habitat features are incorporated in a bank stabilization project, or
- work that decreases sediment loading to the surface water system.

Assignments of a Not Likely to Adversely Affect (N) baseline indicator may include, but is not limited to, the following:

- Maintenance activities which are: (1) conducted entirely within the developed transportation system right-of-way, (2) do not remove vegetation, (3) do not alter existing hydrology through modified discharges and (4) do not discharge materials (such as water, asphalt grindings, fill material) off of the developed portion of the roadway.
- Maintenance activities that complete in-water work while listed fish species are not likely to be present, or
- Work that is limited to installation or repair that occurs without impacting riparian vegetation.

Assignments of a Likely to Degrade (-) baseline indicator may include, but is not limited to, the following:

- Maintenance activities that involve earthwork in critical habitat within 100 feet of the OHWM without Spill Control and Containment Plan and Erosion control measures.
- Paving associated activities that occur within 300 feet or above or involve in-water work, which result in alterations to the hydrodynamics, stream substrate, or bank and the impact is not discountable.
- Work that permanently removes vegetation

- Maintenance activities that involve in-water work when listed fish species are likely to be present.

Once an HPA is issued, the "Likely to Degrade baseline indicator" will change to a "Not Likely to Adversely Affect." HPAs are issued by WDFW for activities that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state pursuant to Chapter 75.20 RCW. Each HPA is conditioned to avoid and/or mitigate impacts to fish life.

An assignment of an Unknown (U) effect on baseline indicator was assigned when the effect is not known due to the lack of information. An example is how maintenance activities affect on Recruitment, Population Structure, and Heterogeneity.

Table 23 highlights the general effects of the maintenance activity components on the baseline indicators without the BMPs in the Regional Program implemented. The effects listed in this table are those thought to be primary and most likely to occur.

Table 24 highlights the general effects of the maintenance activity components on the baseline indicators with the BMPs in the Regional Program implemented. In some cases, two effects on baseline indicator were assigned. For example, adjacent to the stream and in stream culvert cleaning, associated with the physical barrier baseline indicator, is categorized as a Not Likely to Adversely Affect (N) and a Likely to Restore baseline indicator (+). In this case two effect categories were used to depict the possible outcomes. Culvert cleaning, because it often removes built up sediment or debris that was unable to pass through the existing culvert, would cause a Likely to Restore baseline indicator (+) to occur. Culvert cleaning has the potential to remove the physical barrier caused by sediment or debris. If there were not a sediment or debris physical barrier in existence, a Not Likely to Adversely Affect (N) would be assigned. Table 24 also depicts the changes that occurred with implementation of the BMPs. The colored cells show activities that have improved the baseline indicator with implementation of the BMPs.

Table 25 identifies the recommended BMPs that are used to avoid and minimize impacts and subsequent conservation measures to the aquatic habitat. This table identifies the BMPs for maintenance activities that indicate a Likely to Degrade baseline indicator. With the addition of the HPA, these indicators may change to Not Likely to Adversely Affect the baseline indicator. As stated above, HPAs are issued by WDFW for activities that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state pursuant to Chapter 75.20 RCW. Each HPA is conditioned to avoid and/or mitigate impacts to fish life.

Table 26 illustrates the components (i.e. clearing, drilling, culvert cleaning) and how the components impact aquatic habitat. Table 26 then identifies the effects and potential outcomes that occur with the Regional Program implemented. For example, culvert cleaning may impact habitat by mobilizing sediments, but with the guidelines implemented the potential outcomes include, but are not limited to reducing sediment conveyance and loading to watercourses and/or streams by trapping and removing sediment and/or debris from the system and it may restore or maintain surface water drainage.

Table B-2, in Appendix B, is an example of various maintenance work activities, a description of what those activities are and a link to which classification they belong in. For example, access road maintenance involves surface grading, shaping and rocking of the road surface. This activity would be included in the earth/surface or cleaning work, vegetation and chemical classifications.

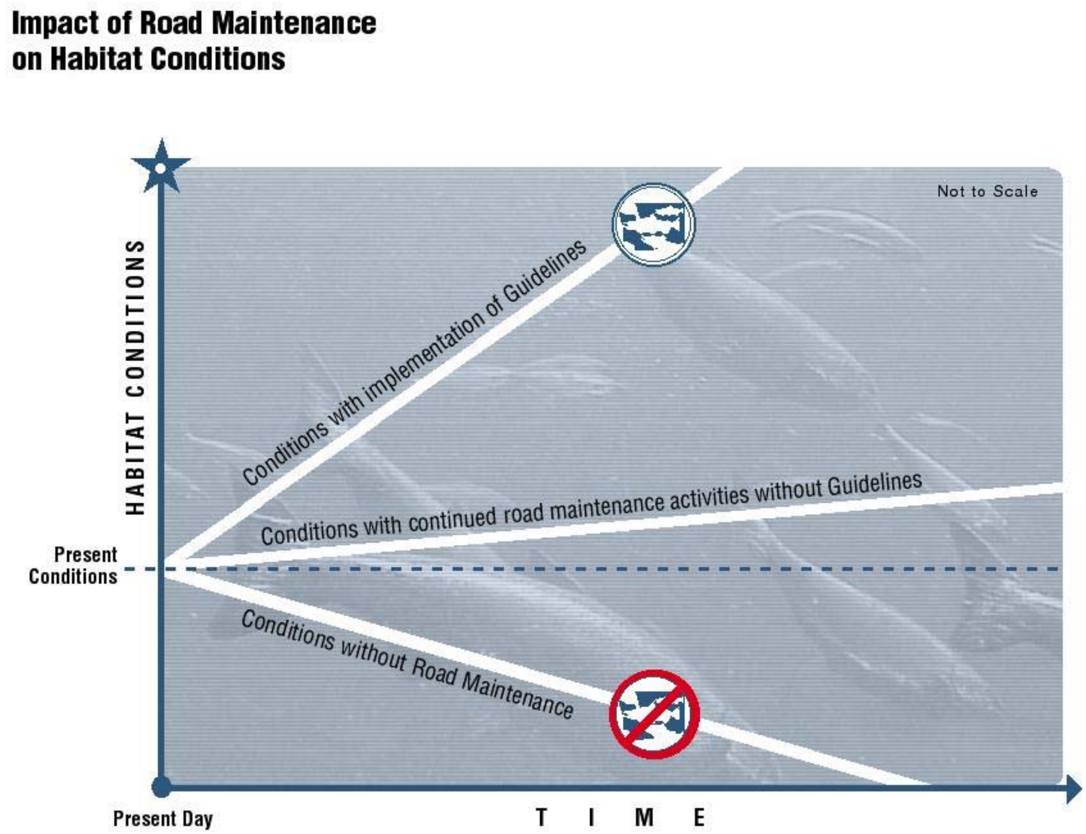
6.3.5 Results of BMP Analysis

Unlike development or redevelopment, road maintenance can be a method of mitigating the impacts of the original construction, or existence, of a structure. Thus, road maintenance can contribute to PFC. In some cases, however, road maintenance work can potentially result in an adverse habitat impact. In nearly all cases, the only adverse impacts of road maintenance activities are short term, with long-term positive habitat benefits.

Road maintenance mitigates the impacts of the original construction of the road structures, ongoing roadway use, and preservation of the structure. Road maintenance can also lead to habitat improvement. Figure 7 shows the impact of road maintenance on habitat conditions under three scenarios:

1. If road maintenance were to cease altogether, habitat conditions would decline
2. With current road maintenance practices, habitat conditions would improve slowly
3. With implementation of the *Guidelines*, habitat conditions would improve at a greater rate.

Figure 7. Impact of Road Maintenance on Habitat Conditions.



If the Regional Program were not implemented, there would be many cases where activities could cause a Likely to Degrade baseline indicator level. With implementation of the Regional Program, nearly all "Likely to Degrade" (-) baseline indicators change to "Likely to Restore baseline indicators" (+), "Not Likely to Adversely Affect" (N) or "Unknown effect" (U). This improvement in baseline indicators is due to the way the Regional Program was developed. It was developed with the idea that the BMPs must be outcome based. Rather than providing a "cookbook recipe" approach to BMPs, the Regional Road Maintenance Program BMP standards focus on the following outcomes:

- Minimizing erosion/sedimentation
- Containing pollutants
- Maximizing habitat improvements.

When specific BMPs are selected based on worksite conditions, any adverse effects of road maintenance are minimized and habitat improvements maximized. Thus, the overall impact of the Regional Program is to conserve habitat and contribute to PFC as a result of performing road maintenance.

Following are the detailed tables, as described above, that were used in the analysis of the BMPs. These tables are also included in Appendix B in 11 x 17 format.

Table 22: Routine Road Maintenance Program Activity Components

Maintenance Activity			Categories														
Proximity	Classification	Components	Roadway Surface	Enclosed Drainage Systems	Cleaning Enclosed Drainage System	Open Drainage Systems	Watercourse & Streams	Stream Crossings	Gravel Shoulders	Street Surface Cleaning	Bridge Maintenance	Snow & Ice Control	Emergency Slide/ Washout Repair	Concrete	Sewer Systems	Water Systems	Vegetation Management
Distant from Stream (>300 ft away)	Earth/ Surface Work	Clearing, Drilling, Excavation, Filling, Grading, Grubbing, Cleaning, Grinding or Cutting	X	X	X	X			X	X	X	X	X	X	X	X	X
	Hydraulic modification	Channelization or Diking				X							X				
		Culvert Cleaning															
		Culvert Extension, Reduction Replacement															
		Deposition of Large Woody Debris											X				X
		Removal of Large Woody Debris											X				X
		Temporary Water Diversion											X				
	Vegetation Modification	Long Term Removal of Vegetation				X			X		X		X		X	X	X
		Permanent Removal of Vegetation							X		X		X		X	X	X
		Planting Vegetation		X		X					X		X	X	X	X	X
		Short Term Removal of Vegetation		X		X					X	X		X	X	X	X
	Paving/Concrete	Addition of Impervious Surface	X														
		Maintenance of existing	X														
	Chemical	Fuel & Industrial Fluids Present	X	X	X	X			X	X	X	X	X	X	X	X	X
		Painting	X								X						
		Uncured Concrete, Hot Asphalt or Hot Tar Used	X								X		X	X			
Adjacent to or Above Stream (within 300 ft)	Earth/Surface or cleaning Work	Clearing, Drilling, Excavation, Filling, Grading, Grubbing, Cleaning, Grinding or Cutting	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		Heavy Equipment Present	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		Shore Defense Works					X	X			X		X				
	Hydraulic modification	Channelization or Diking															
		Culvert Cleaning															
		Culvert Extension, Reduction Replacement															
		Deposition of Large Woody Debris															X
		Removal of Large Woody Debris															X
		Temporary Water Diversion															
	Vegetation Modification	Long Term Removal of Vegetation					X		X		X		X				X
		Permanent Removal of Vegetation					X		X		X		X				X
		Planting Vegetation		X		X	X	X			X		X				X
		Short Term Removal of Vegetation		X		X	X	X			X	X	X	X	X	X	X
	Paving/Concrete	Addition of Impervious Surface	X														
		Maintenance of existing	X														
	Structure Work	Bridge Debris Removal					X	X			X		X				
		Bridge Deck work/general repair									X						
	Chemical	Fuel & Industrial Fluids Present	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		High Pressure Washing/Flushing		X	X					X	X	X			X	X	
		Painting	X								X						
		Uncured Concrete, Hot Asphalt or Hot Tar Used	X								X		X	X			
Instream	Earth Work	Drilling, Excavation, & Filling					X	X			X		X				
		Heavy Equipment Present					X	X					X				
		Manual Labor Present					X	X					X				X
		Shore Defense Works					X	X									
	Hydraulic modification	Channelization or Diking					X	X					X				
		Culvert Cleaning					X	X					X				
		Culvert Extension, Reduction Replacement					X	X									
		Deposition of Large Woody Debris					X	X			X		X				X
		Removal of Large Woody Debris					X	X			X		X				
		Temporary Water Diversion					X	X			X		X				
	Structure Work	Barge Present					X	X			X		X				
		Bridge Debris Removal					X	X			X		X				
		Falsework, Cofferdam, or Other Temporary Structure Placement						X			X						
		Pier, Footing, abutment scour									X						
	Chemical	Fuel & Industrial Fluids Present					X	X			X		X				
		High Pressure Washing/Flushing						X			X						
		Uncured Concrete Used									X						
		Treated woods (in stream only)									X						

11/21/01

Table 23: Activities and Effects: Without Guidelines Implemented

Maintenance Activity																						
Proximity	Classification	Components	Temperature	Sediment	Contamination	Physical Barriers	Substrate	Large Woody Debris	Pool Frequency	Pool Quality	Large Pools	Off Channel Habitat	Refugia	Width/ Depth Ratio	Streambank Condition	Channel Confinement	Flood Plain Connectivity	Peak & Base Flows	Drainage Network	Road Density	Disturbance History	Riparian Corridor	Recruitment & Pop-Hetro
Distant from Stream (>300 ft away)	Earth/ Surface Work	Clearing, Drilling, Excavation, Filling, Grading, Grubbing, Cleaning, grinding or cutting	-	-	U / -	N	-	N	N	N	N	-	-	N	N	N	N	U	-	N	-	-	U
	Hydraulic modification	Channelization or Diking	N	N	U / -	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U	N	U
		Culvert Cleaning	N	N	U / -	N	N	N	N	N	N	N	N	N	N	N	N	+	N	N	U	N	U
		Culvert Extension, Reduction	N	N	U / -	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
		Culvert Replacement	N	N	U / -	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
		Deposition of Large Woody Debris	N	N	U / -	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
		Removal of Large Woody Debris	N	N	U / -	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
		Temporary Water Diversion	N	N	U / -	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
	Vegetation Modification	Long Term Removal of Vegetation	-	-	U	N	-	-	-	-	-	-	-	-	-	-	N	-	-	N	-	-	U
		Permanent Removal of Vegetation	-	-	U	N	-	-	-	-	-	-	-	-	-	-	N	-	-	N	-	-	U
		Planting Vegetation	+	+	U	N	+	+	+	+	+	+	+	+	+	+	N	+	+	N	+	+	U
		Short Term Removal of Vegetation	-	-	U	N	-	N	N	N	N	N	N	N	N	N	N	-	N	N	U	U	U
	Paving/Concrete	Addition of Impervious Surface	U	-	-	N	-	N	N	N	N	-	-	N	N	N	-	-	-	-	U	-	U
		Maintenance of existing	N	-	-	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
	Chemical	Fuel & Industrial Fluids Present	N	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		Painting	N	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		Uncured Concrete, Hot Asphalt or Hot Tar Used	N	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Adjacent to or Above Stream (within 300 ft)	Earth/Surface or cleaning Work	Clearing, Drilling, Excavation, Filling, Grading, Grubbing, Cleaning, grinding or cutting	-	-	U / -	N	-	N	U	U	U	-	-	U	-	-	-	-	-	N	U	-	U
		Heavy Equipment Present	N	-	-	N	-	N	N	N	N	N	N	N	-	N	N	N	N	N	U	N	U
		Shore Defense Works	N	-	U / -	N / -	-	N	N	N	N	-	N	N	-	-	-	-	N	N	-	-	U
	Hydraulic modification	Channelization or Diking	-	-	U / -	U	-	U/ -	-	-	-	-	-	-	-	-	-	-	U	N	U	U / -	U
		Culvert Cleaning	-	-	-	N	-	N	N	-	-	-	-	N	N	N	-	-	N	N	U	N	U
		Culvert Extension, Reduction	U	-	U / -	U / -	-	U	U	U	U	U	U	-	U	-	-	U	U	N	U	U	U
		Culvert Replacement	-	-	-	U / -	-	-	-	-	-	N	N	-	-	-	-	-	U	N	U	U	U
		Deposition of Large Woody Debris	+	-	U / -	U / -	U / -	+	U	U	U	U	U	N	- / +	N	N	U	N	N	U	U	U
		Removal of Large Woody Debris	-	-	U / -	N	-	-	U	-	U	U	U	N	U	U	N	U	N	N	U	U	U
		Temporary Water Diversion	-	-	-	U	-	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
	Vegetation Modification	Long Term Removal of Vegetation	-	-	U	N	-	U / -	-	-	-	-	-	-	-	-	-	-	-	N	-	-	U
		Permanent Removal of Vegetation	-	-	U	N	-	-	-	-	-	-	-	-	-	-	-	-	-	N	-	-	U
		Planting Vegetation	+	+	U	N	+	+	+	+	+	+	+	+	+	+	U	+	+	N	+	+	U
		Short Term Removal of Vegetation	-	-	U	N	U / -	U/ -	U	U/ -	U	-	-	N	-	N	-	-	-	N	U	-	U
	Paving/Concrete	Addition of Impervious Surface	-	-	-	U	-	N	-	-	-	-	-	-	-	-	-	-	-	-	U	-	U
		Maintenance of existing	U	U	-	N	U	N	N	U	N	N	N	N	U	N	N	N	N	N	U	N	U
	Structure Work	Bridge Debris Removal	N	-	-	N	-	N	N	-	-	N	N	N	N	N	N	N	N	N	U	N	U
		Bridge Deck work/general repair	N	-	-	N	-	N	N	-	-	N	N	N	N	N	N	N	N	N	U	N	U
	Chemical	Fuel & Industrial Fluids Present	N	N	-	N	N	N	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N
		High Pressure Washing/Flushing	-	-	-	N	-	N	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N
		Painting	N	N	-	N	N	N	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N
		Uncured Concrete, Hot Asphalt or Hot Tar Used	-	N	-	N	-	N	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N
Instream	Earth Work	Drilling, Excavation, & Filling	-	-	U/ -	U	-	U	-	-	-	U	-	-	-	-	-	-	U	N	U	-	U
		Heavy Equipment Present	-	-	-	N	-	N	-	-	-	N	N	-	-	N	N	N	N	N	U	N	U
		Manual Labor Present	N	-	U / -	N	-	N	N	N	N	N	N	N	U	N	N	N	N	N	U	N	U
		Shore Defense Works	-	-	U / -	N / -	-	U	-	-	-	-	-	-	-	-	U / -	-	U	N	-	-	U
	Hydraulic modification	Channelization or Diking	-	-	U/ -	U	-	U/ -	-	-	-	-	-	-	-	-	-	-	U	N	-	N / -	U
		Culvert Cleaning	U	-	U / -	N	-	U	U	-	-	-	-	U	U	N	-	-	N	N	U	N / +	U
		Culvert Extension, Reduction	-	-	U / -	U / -	-	-	-	-	-	-	-	-	-	-	-	U	U	N	U	U	U
		Culvert Replacement	-	-	U/ -	U/ -	-	U	-	-	U	U	U	U	-	-	-	-	U	N	U	U	U
		Deposition of Large Woody Debris	+	-	U / -	U/ -	-	+	+	U	U	- / +	- / +	- / +	- / +	N	N	U	N	N	U	U	U
		Removal of Large Woody Debris	-	-	U / -	U	-	-	U / -	U / -	U / -	U / -	U / -	U	U / -	U	N	U	N	N	U	U	U
		Temporary Water Diversion	-	-	-	-	-	N	-	-	N	N	N	N	N	N	N	N	N	N	U	N	U
	Structure Work	Barge Present	U	-	U/ -	U	-	N	N	U	U	U	U	U	U	U	U	U	N	N	U	N	U
		Bridge Debris Removal	U	-	U / -	N	-	-	U	-	-	-	U	-	-	-	U	U	N	N	U	U / -	U
		Falsework, Cofferdam, or Other Temporary Structure Placement	-	-	U / -	-	-	N	N	N	N	N	-	-	-	-	-	-	N	N	U	N	U
		Pier, Footing, abutment scour	U	-	-	U	-	N	-	U	U / -	N	U	U	U	U	U	U	N	N	U	N	U
	Chemical	Fuel & Industrial Fluids Present	U	N	-	N	N	N	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N
		High Pressure Washing/Flushing	U	-	-	N	-	N	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N
		Uncured Concrete Used	U	-	-	N	-	N	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N
		Treated woods (In stream only)	U	N	-	N	N	N	N	-	N	N	N	N	N	N	N	N	N	N	N	N	N

Effect Key (+) Likely to restore baseline indicator (-) Likely to degrade baseline indicator (U) Unknown effect (N) Not Likely to Adversely Affect

12/11/01

Table 24: Activities and Effects: With the Guidelines Implemented

Maintenance Activity: Proximity	Classification	Components	Temperature	Sediment	Contamination	Physical Barriers	Substrate	Large Woody Debris	Pool Frequency	Pool Quality	Large Pools	Off Channel Habitat	Refugia	Width/ Depth Ratio	Streambank Condition	Channel Confinement	Flood Plain Connectivity	Peak & Base Flows	Drainage Network	Road Density	Disturbance History	Riparian Corridor	Recruitment & Pop-Hetro
Distant from Stream (>300 ft away)	Earth/ Surface Work	Clearing, Drilling, Excavation, Filling, Grading, Grubbing, Cleaning, grinding or cutting	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N/U	N	U	N/+	U
	Hydraulic Modification	Channelization or Diking	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U	N	U
		Culvert Cleaning	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	+	N	N	U	N	U
		Culvert Extension, Reduction	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
		Culvert Replacement	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
		Deposition of Large Woody Debris	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
		Removal of Large Woody Debris	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
		Temporary Water Diversion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
	Vegetation Modification	Long Term Removal of Vegetation	- /+	U	N	N	U	N	N	N	N	N	N	N	U	N	N	-	N	N	U	U /+	U
		Permanent Removal of Vegetation	-	U	N	N	U	N	N	N	N	N	N	N	U	N	N	-	N	N	U	-	U
		Planting Vegetation	+	+	N	N	+	+	+	+	+	+	+	+	+	+	N	+	+	N	+	+	U
		Short Term Removal of Vegetation	+	+	N	N	+	N	N	N	N	N	N	N	+	N	N	N /+	N	N	U	+	U
	Paving/Concrete	Addition of Impervious Surface	U	U	N	N	U	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
		Maintenance of existing	N	+	N	N	+	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
	Chemical	Fuel & Industrial Fluids Present	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		Painting	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		Uncured Concrete, Hot Asphalt or Hot Tar Used	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Adjacent to or Above Stream (within 300 ft)	Earth/Surface or cleaning Work	Clearing, Drilling, Excavation, Filling, Grading, Grubbing, Cleaning, grinding or cutting	N/-	N/-	N	N	N/-	N	U	U	U	N /-	N /-	N /U	N /-	N /-	N /-	N /-	N /U	N	U	N /+	U
		Heavy Equipment Present	N	N	N	N	N	N	N	N	N	N	N	N	N /-	N	N	N	N	N	U	N	U
		Shore Defense Works	N	U /+	N	N /+	U /+	N	N /+	N /+	N /+	U	N /+	N	N /+	U /-	N /-	N /-	N	N	U	+	U
	Hydraulic Modification	Channelization or Diking	-	-	N	N	-	N /+	N /-	N /-	N /-	N /-	N /-	N /-	N /-	N /-	N /-	N /-	N /+	N	U	N /-	U
		Culvert Cleaning	+	+	N	N /+	+	N	N	+	+	+	N /+	N	N	N	+	+	N	N	U	N /+	U
		Culvert Extension, Reduction	U	N /+	N	N /+	N /+	U	U	U	U	U	U	U	U /+	U	U	U	U	N	U	U	U
		Culvert Replacement	+	+	N	+	+	N /+	U	+	+	+	+	N /+	+	N /+	+	+	N	N	U	U /+	U
		Deposition of Large Woody Debris	+	+	N	N	+	+	U /+	U /+	+	U /+	N /+	N /+	N /+	N	N	N	N	N	U	+	U
		Removal of Large Woody Debris	N/-	N/-	N	N	N / -	N /-	U	U	U	U	U	N	U	U	N	N	N	N	U	U	U
		Temporary Water Diversion	N	N	N	U	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
	Vegetation Modification	Long Term Removal of Vegetation	-/+	- /+	N	N	- /+	- /+	U /+	- /+	- /+	- /+	- /+	- /+	N	N	- /+	- /+	N	N	U	U /+	U
		Permanent Removal of Vegetation	-	-	N	N	-	-	-	-	-	-	-	-	-	N	-	-	N	N	U	-	U
		Planting Vegetation	+	+	N	N	+	+	+	+	+	+	+	+	+	+	U	+	+	N	+	+	U
		Short Term Removal of Vegetation	-/+	U /+	N	N	U /+	N /+	U /+	U /+	U /+	- /+	- /+	N /+	N /+	N	N /+	-/+	N	N	U	U /+	U
	Paving/Concrete	Addition of Impervious Surface	-	U	N	N	U	N	N	U	U	N	N	N	U	N	N	N	N	N	U	N	U
		Maintenance of existing	N	U	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
	Structure Work	Bridge Debris Removal	N	+	N	N	+	N	N	+	+	N	N	N	N	N	N	N	N	N	U	N	U
		Bridge Deck work/general repair	N	+	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
	Chemical	Fuel & Industrial Fluids Present	N	N	N/-	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		High Pressure Washing/Flushing	N/-	N/-	N /-	N	N/-	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		Painting	N	N	N /-	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		Uncured Concrete, Hot Asphalt or Hot Tar Used	N/-	N	N /-	N	N/-	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Instream	Earth Work	Drilling, Excavation, & Filling	-	N/-	N	U	N/-	N	U	- /+	- /+	N	- /+	-	- /+	- /+	-	-	U	N	U	N /+	U
		Heavy Equipment Present	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
		Manual Labor Present	N	U	N	N	U	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
		Shore Defense Works	N /+	- /+	N	N /+	- /+	N /+	N /+	N /+	N /+	U	N /+	U	+	U /-	U /-	U	U	N	U	+	U
	Hydraulic modification	Channelization or Diking	-	-	N	N	-	U	-	-	-	-	-	-	-	-	-	N /+	N /+	N	U	- /+	U
		Culvert Cleaning	U	N /+	N	N /+	N /+	U	U	U /+	U /+	U /+	N /+	U	N /+	N	+	+	N	N	U	N /+	U
		Culvert Extension, Reduction	N	N	N	N /+	N	U	U	U	U	U	U	U	U /+	U	U	U	U	N	U	U	U
		Culvert Replacement	N	U	N	+	+	N /+	U	+	+	U /+	N /+	N /+	+	N /+	N /+	+	N	N	U	U /+	U
		Deposition of Large Woody Debris	+	+	N	N	+	+	U /+	U /+	U /+	N /+	N /+	N /+	N /+	N	N	N	N	N	U	+	U
		Removal of Large Woody Debris	U/-	U/-	N	N	U /-	-	U	U /-	U	U	U	U	U	U	N	N	N	N	U	U	U
		Temporary Water Diversion	U/-	N	N	N /-	N	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
	Structure Work	Barge Present	U	U	N	U	U	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
		Bridge Debris Removal	U	N	N	N	N	N	U	N	N	N	N	N	N	N /+	N	N	N	N	U	N	U
		Falsework, Cofferdam, or Other Temporary Structure Placement	U/-	N /-	N	N /-	N / -	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
		Pier, Footing, abutment scour	U	U	N	N	U	N	N	N	N	N	N	N	N	N	N	N	N	N	U	N	U
	Chemical	Fuel & Industrial Fluids Present	U	N	N /-	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		High Pressure Washing/Flushing	U	N/-	N /-	N	N/-	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		Uncured Concrete Used	U	N	N /-	N	N/-	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
		Treated woods (In stream only)	U	N	N /-	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Effect Key (+) Likely to restore baseline indicator (-) Likely to degrade baseline indicator (U) Unknown effect (N) Not Likely to Adversely Affect Improvement

12/12/01

Table 25: Best Management Practices to Avoid and Minimize Impact

Maintenance Activity			Disturbed Areas															Outcome Categories / Part 2 BMPs								Equipment/Tools								
Proximity	Classification	Components	All exposed & unworked soils shall be stabilized by application of effective BMPs, which protect the soil from the erosive forces of raindrop impact & flowing water. - During the winter season, October through June, no soils shall remain exposed and unworked for more than 2 days. - During the summer season, July through September, no soils shall remain exposed and unworked for more than 7 days. - These conditions apply to all soils on site, whether or not at final grade.	As BMP's are no longer needed, they will be removed and the area disturbed by the BMP removal will be cleaned, reseeded, and/or repaired.	After removal of sediments, replant disturbed soils with grasses and small forbs.	Leave vegetative buffer outside of work zone to provide bio-filtration and shading on back slope of ditch.	Leave vegetative buffer of grasses and small forbs between the shoulder and ditch if the area is wide enough.	Leave vegetated section in ditchline, where sediment buildup does not impede flow or infiltration.	Minimize disturbance to riparian vegetation. Mark job site, flag work area, and operate/position equipment to minimize damage to riparian habitat.	Monitor water quality.	Monitor plantings in accordance with permit requirements.	After BMPs are removed clean up accumulated sediments and hydroseed or replant disturbed area.	Restore vegetation appropriate for site conditions within riparian areas.	Monitor vegetation and stream habitat in accordance with permitting requirements.	Minimize disturbance of vegetation outside of the shoulder area, leave vegetative strip where possible between the gravel and the ditch line for biofiltration.	Leave BMPs in place and monitor, until vegetation is established (HPA).	Protect outflows by bio-vegetation techniques or armoring to reduce erosion.	Keep Water from work area.	Reduce Soil from becoming Water or Air Borne.	Filter/Perimeter Protection.	Settling.	Reduce Water Velocity/Erosive Forces.	Containment.	Habitat Protection/Maintenance.	Reduce Contaminants Falling into Water.	Tool and Equipment cleanup procedures: Routinely inspect equipment, tools and vehicles for leaks or damage. Keep cleanup materials, such as dry absorbent materials, on site to allow prompt cleanup of spills. Promptly repair or replace leaking connections, pipes, hoses and/or valves.	Vehicle and equipment maintenance, repair and/or service will be performed at designated repair facilities whenever possible. To reduce the potential for discharge of pollutants to watercourses or streams from vehicle and equipment maintenance, service and repair operations, follow the practices listed below: - Prohibit discharge of any waste waters to the stormwater drains. Do not pour material down drains or hose down work areas. Use dry sweeping or damp mopping. - Remove build up of oils and grease on equipment. - Perform equipment and vehicle maintenance in areas that prevent discharges to the storm drain system. - Use drip pans under equipment when maintaining, repairing or servicing in the field. - Use non-toxic solvents whenever possible. - Clean maintenance area storm drain grates regularly.	At end of shift, park equipment in designated areas.	Clean equipment and tools off site in area where pollutants can be contained.	If unable to move tools and equipment off site, control and remove with a release agent. Before travel, bucket will be secured and have lid on to prevent spills.	When using high-pressure flushing equipment, vacuum out solids to reduce sediment and turbidity from moving downgrade throughout the drainage system.	Control speed of sweeper to minimize airborne particulates and remove maximum amount of debris.	Use water spray system on sweeper to reduce dust.	Use pickup sweepers to remove materials from roadway in assigned areas.
Distant from Stream (>300 ft. away)	Vegetation Modification	Long Term Removal of Vegetation	x	x	x	x	x	x	x			x	x		x		x		x	x		x													
		Permanent Removal of Vegetation	x	x	x	x	x	x	x			x	x		x				x	x		x													
	Paving/Concrete	Addition of Impervious Surface																	x	x		x				x	x	x	x	x					
	Chemical	Fuel & Industrial Fluids Present																x		x			x												
		Painting																x		x			x												
		Uncured Concrete, Hot Asphalt or Hot Tar Used																x		x			x												
Adjacent to or Above Stream (within 300 ft)	Earth/Surface or cleaning Work	Clearing, Drilling, Excavation, Filling, Grading, Grubbing, Cleaning, grinding or cutting	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x						x	x	x	x
		Heavy Equipment Present				x			x				x													x	x	x	x	x				
		Shore Defense Works	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x		x	x									
	Hydraulic modification	Channelization or Diking	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x									
		Removal of Large Woody Debris		x					x	x	x		x	x		x		x	x	x		x		x	x									
		Temporary Water Diversion		x						x								x	x	x	x	x		x	x									
	Vegetation Modification	Long Term Removal of Vegetation	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x		x												
		Permanent Removal of Vegetation	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x		x												
		Short Term Removal of Vegetation	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x		x												
	Paving/Concrete	Addition of Impervious Surface																	x	x		x				x	x	x	x	x					
		Maintenance of existing																	x	x		x				x	x	x	x	x					
	Chemical	Fuel & Industrial Fluids Present																x		x			x												
		High Pressure Washing/Flushing								x								x		x			x												
		Painting																x		x			x												
		Uncured Concrete, Hot Asphalt or Hot Tar Used																x		x			x												
Instream	Earth Work	Drilling, Excavation, & Filling	x	x					x	x	x		x	x		x		x		x	x	x		x	x							x	x	x
		Heavy Equipment Present							x				x													x	x	x	x	x				
		Manual Labor Present							x				x													x	x	x	x	x				
		Shore Defense Works		x					x	x	x		x	x		x		x		x	x	x		x	x									
	Hydraulic modification	Channelization or Diking	x	x					x	x	x		x	x		x		x		x	x	x		x	x									
		Culvert Cleaning		x						x						x		x		x	x	x		x	x									
		Culvert Extension, Reduction, Replacement		x					x	x	x		x	x		x		x		x	x	x		x	x									
		Removal of Large Woody Debris		x						x	x		x	x		x		x																
		Temporary Water Diversion		x						x			x			x		x																
	Structure Work	Bridge Debris Removal								x			x	x		x																x	x	x
		Falsework, Cofferdam, or Other Temporary Structure Placement							x	x			x	x		x		x		x	x	x		x										
		Pier, Footing, abutment scour	x						x	x			x	x		x		x																
	Chemical	Fuel & Industrial Fluids Present																x		x			x												
		High Pressure Washing/Flushing																x		x			x									x	x	x
		Uncured Concrete Used																x		x			x												
		Treated woods (in stream only)																x		x			x												

Table 25: Best Management Practices to Avoid and Minimize Impacts (Continued)

Maintenance Activity			Spill Prevention & Control	Material/Debris Disposal							Permits				
Proximity	Classification	Components	Carry spill kit used for small spills related to equipment failure. Desired outcome is to control, absorb, or contain spill for clean up and disposal. Minimum requirements: Absorbent, Pads, & Shovel.	Cleaning waste materials and demolition debris occurring onsite shall be handled and disposed of in a manner that does not cause contamination of water.	After repairs are completed, remove construction/maintenance waste materials from site for disposal or recycling.	If area is swept with a pick-up sweeper, the material will be hauled out of the area to appropriate disposal site.	Removed construction/maintenance waste materials from work site will be taken to a disposal of and/or recycling area.	Remove and dispose of collected materials and liquids offsite.	Solid materials removed from the site will be taken to a disposal or recycling area.	Use pickup sweepers to remove materials from roadway in assigned areas.	Maintenance activities within waters of the State will be reviewed with the WSDFW, HPA as negotiated with NMFS/USFWS, and permitted prior to work.	All stream crossing repair, replacement or maintenance work within the waters of the State will be reviewed with the WSDFW, HPA as negotiated with NMFS/USFWS and permitted prior to work.	Bridge maintenance activities requiring an HPA will be reviewed with the WSDFW, and permitted prior to construction, in accordance with the HPA's as negotiated with NMFS and USFWS.	Maintenance activities within waters of the State will be covered under "Watercourses and Streams".	Periodically remove sediment deposits and vegetation during the dry season with a motor grader.
Distant from Stream (> 300 ft. away)	Vegetation Modification	Long Term Removal of Vegetation	x												x
		Permanent Removal of Vegetation													
	Paving/Concrete	Addition of Impervious Surface	x	x	x										
	Chemical	Fuel & Industrial Fluids Present	x												
		Painting	x												
		Uncured Concrete, Hot Asphalt or Hot Tar Used	x												
Adjacent to or Above Stream (within 300 ft)	Earth/Surface or cleaning Work	Clearing, Drilling, Excavation, Filling, Grading, Grubbing, Cleaning, grinding or cutting		x	x	x	x	x	x	x	x		x		x
		Heavy Equipment Present	x			x			x		x				
		Shore Defense Works									x				
	Hydraulic modification	Channelization or Diking												x	
		Removal of Large Woody Debris				x	x							x	
		Temporary Water Diversion												x	
	Vegetation Modification	Long Term Removal of Vegetation							x						
		Permanent Removal of Vegetation							x						
		Short Term Removal of Vegetation							x						x
	Paving/Concrete	Addition of Impervious Surface	x	x	x										
		Maintenance of existing	x	x	x										x
	Chemical	Fuel & Industrial Fluids Present	x												
		High Pressure Washing/Flushing	x					x						x	
		Painting	x											x	
		Uncured Concrete, Hot Asphalt or Hot Tar Used	x												
Instream	Earth Work	Drilling, Excavation, & Filling		x	x	x				x	x	x	x	x	
		Heavy Equipment Present	x			x								x	
		Manual Labor Present	x											x	
		Shore Defense Works		x	x						x	x		x	
	Hydraulic modification	Channelization or Diking		x	x						x	x		x	
		Culvert Cleaning		x	x						x	x		x	
		Culvert Extension, Reduction, Replacement		x	x		x				x	x		x	
		Removal of Large Woody Debris		x	x						x	x		x	
		Temporary Water Diversion		x	x						x			x	
	Structure Work	Bridge Debris Removal		x	x		x			x	x	x	x	x	
		Falsework, Cofferdam, or Other Temporary Structure Placement		x	x						x	x	x	x	
		Pier, Footing, abutment scour			x						x	x	x	x	
	Chemical	Fuel & Industrial Fluids Present	x												
		High Pressure Washing/Flushing	x					x		x				x	
		Uncured Concrete Used	x												
		Treated woods (in stream only)	x												

Maintenance Activity			Fish Exclusion		Timing				Habitat Measures			Shoulder Work	Painting/ Marking	
Proximity	Classification	Components	Fish Exclusion Protocol and permit conditions will be followed during maintenance activities.	Fish will be excluded from construction area using appropriate methods such as the use of nets, dewatering at a controlled rate, and removal of stranded fish according to HPA permit conditions as negotiated with NMFS/USFWS.	Plan and schedule work in dry conditions or when flows are anticipated to be at their lowest.	If seasonal watercourse or stream, schedule work during dry conditions.	Plan and schedule work in dry or low flow conditions, except in emergency situations (HPA).	If bridge maintenance is to be performed near a seasonal watercourse or stream, schedule the work during dry conditions.	Maintain or add areas of spawning, migration, feeding, or rearing habitat as directed by WSDFW (HPA).	Place appropriate streambed material (HPA).	Habitat restoration to be designed and constructed in accordance with applicable local, state and federal guidelines.	Maximize opportunities for shoulder work, which will increase infiltration or biofiltration.	Follow state and federal guidelines for handling paint and other traffic marking materials.	Stripe roadways in dry weather.
Distant from Stream (> 300 ft. away)	Vegetation Modification	Long Term Removal of Vegetation												
		Permanent Removal of Vegetation												
	Paving/Concrete	Addition of Impervious Surface												
	Chemical	Fuel & Industrial Fluids Present												
		Painting											x	x
		Uncured Concrete, Hot Asphalt or Hot Tar Used												
Adjacent to or Above Stream (within 300 ft)	Earth/Surface or cleaning Work	Clearing, Drilling, Excavation, Filling, Grading, Grubbing, Cleaning, grinding or cutting			x		x	x			x	x		
		Heavy Equipment Present			x									
		Shore Defense Works			x	x	x		x	x	x			
	Hydraulic modification	Channelization or Diking									x			
		Removal of Large Woody Debris				x	x		x		x			
		Temporary Water Diversion												
	Vegetation Modification	Long Term Removal of Vegetation									x			
		Permanent Removal of Vegetation									x			
		Short Term Removal of Vegetation									x			
	Paving/Concrete	Addition of Impervious Surface												
		Maintenance of existing												
	Chemical	Fuel & Industrial Fluids Present												
		High Pressure Washing/Flushing												
		Painting											x	x
		Uncured Concrete, Hot Asphalt or Hot Tar Used												
Instream	Earth Work	Drilling, Excavation, & Filling	x	x	x	x	x	x	x	x	x			
		Heavy Equipment Present												
		Manual Labor Present												
		Shore Defense Works	x	x	x	x	x		x	x	x			
	Hydraulic modification	Channelization or Diking	x	x	x	x	x		x	x	x			
		Culvert Cleaning	x	x	x	x	x		x	x				
		Culvert Extension, Reduction, Replacement	x	x	x	x	x		x	x	x			
		Removal of Large Woody Debris	x	x	x	x	x		x	x	x			
		Temporary Water Diversion	x	x	x	x	x		x	x				
	Structure Work	Bridge Debris Removal	x	x	x	x	x	x	x	x	x			
		Falsework, Cofferdam, or Other Temporary Structure Placement	x	x	x	x	x	x	x	x	x			
		Pier, Footing, abutment scour	x	x	x	x	x	x	x	x	x			
	Chemical	Fuel & Industrial Fluids Present												
		High Pressure Washing/Flushing												
		Uncured Concrete Used												
		Treated woods (in stream only)												

Maintenance Activity			Pre-Activity		Gravel Shoulders			Operational						
Proximity	Classification	Components	Use BMPs that include, but are not limited to: - Blocking facility outlet. - Using less water. - Blocking down gradient end of pipe.	Use cleanup procedures that protect water quality, for example, stormwater decant, equipment washing, and waste material storage and disposal.	Remove built up sediment and sod.	Regrade gravel shoulder.	Roll shoulder material to ensure proper grade and retention of sediment control qualities.	Minimize use of salt by reducing salt-to-sand ratios.	Treat sand cleanup as part of the emergency / remove sand as a priority in order to remove sediments.	Prioritize clean up efforts to aquatic habitat areas in order to minimize impacts.	Prioritize clean up areas without sediment collections systems.	Plow snow in areas that allow vegetation to filter and contain sand.	Develop protocols for dechlorination of water.	Develop a flushing program.
Distant from Stream (> 300 ft. away)	Vegetation Modification	Long Term Removal of Vegetation												
		Permanent Removal of Vegetation												
	Paving/Concrete	Addition of Impervious Surface												
	Chemical	Fuel & Industrial Fluids Present												
		Painting												
		Uncured Concrete, Hot Asphalt or Hot Tar Used												
Adjacent to or Above Stream (within 300 ft)	Earth/Surface or cleaning Work	Clearing, Drilling, Excavation, Filling, Grading, Grubbing, Cleaning, grinding or cutting	x	x	x	x	x	x	x	x	x	x	x	x
		Heavy Equipment Present		x										
		Shore Defense Works												
	Hydraulic modification	Channelization or Diking												
		Removal of Large Woody Debris												
		Temporary Water Diversion												
	Vegetation Modification	Long Term Removal of Vegetation												
		Permanent Removal of Vegetation												
		Short Term Removal of Vegetation												
	Paving/Concrete	Addition of Impervious Surface												
		Maintenance of existing						x	x	x	x	x		
	Chemical	Fuel & Industrial Fluids Present												
		High Pressure Washing/Flushing											x	x
		Painting												
		Uncured Concrete, Hot Asphalt or Hot Tar Used												
Instream	Earth Work	Drilling, Excavation, & Filling												
		Heavy Equipment Present												
		Manual Labor Present												
		Shore Defense Works												
	Hydraulic modification	Channelization or Diking												
		Culvert Cleaning												
		Culvert Extension, Reduction, Replacement												
		Removal of Large Woody Debris												
		Temporary Water Diversion												
	Structure Work	Bridge Debris Removal												
		Falsework, Cofferdam, or Other Temporary Structure Placement												
		Pier, Footing, abutment scour												
	Chemical	Fuel & Industrial Fluids Present												
		High Pressure Washing/Flushing											x	x
		Uncured Concrete Used												
		Treated woods (in stream only)												

Table 26: Mechanism of Effects and Potential Outcomes

Maintenance Activity Proximity	Classification	Components	Mechanisms for Effects/Impacts	Effects with Program Potential Outcomes
Distant from Stream (>300 ft away)	Earth/ Surface Work	Clearing, Drilling, Excavation, Filling, Grading, Grubbing, Cleaning, grinding or cutting	Mobilize sediments, Increase erosion rates	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Maintain or restore structure. • Restore or Maintain surface water drainage. • Reduce or trap sediments in gravel shoulder. • Allow infiltration of water in gravel. • Clean roadway surface and remove soil, organics, solid waste and debris from entering Watercourse, streams and/or water bodies. • Reduce sediment loading of shoulders, ditches, detention ponds and watercourses and/or streams. • Reduce the occurrence of vehicles leaving the road surface and entering sensitive areas. • Leave vegetated sections in ditch where sediment buildup has not impeded flow or infiltration.
	Hydraulic Modification	Channelization or Diking	Mobilize sediments, harden banks, prevent re-vegetation, alter hydraulics and flow regime	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Culvert Cleaning	Mobilize sediments	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Reduce sediment conveyance and loading to watercourses and/or streams by trapping and removal of sediment and/or debris from the system. • Restore or maintain surface water drainage. • Reduce overflows/flooding from plugged system. • Maintain and restore water quality by cleaning ditches or structures. • Maintain or restore sediment storage capacity. • Keep structure clear of debris, trash, and yard waste.
		Culvert Extension, Reduction	Mobilize sediments	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Maintain or restore structure. • Restore or maintain surface water drainage by performing repairs. • Reduce turbidity. • Maintain or restore sediment storage capacity. • Keep structure clear of debris, trash, and yard waste.
		Culvert Replacement	Mobilize sediments	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. Maintain or restore structure. • Restore or maintain surface water drainage by performing repairs. • Reduce potential plugging of systems. • Reduce overflows/flooding from plugged system. • Maintain or restore sediment storage capacity. • Keep structure clear of debris, trash, and/or yard waste. • Reduce flooding and erosion from blockages of system by removing obstructions such as debris, trash, yard waste, and/or sediment.
		Enclosed Drainage System Cleaning	Mobilize sediments	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Control storage, delivery, and routing of surface and groundwater, to Control volumes and velocities of stormwater discharge by removing sediments. • Reduce sediment transport from system breaks by cleaning. • Maintain or restore structure. • Reduce turbidity. • Reduce potential plugging of systems. • Reduce overflows/flooding from plugged system. • Maintain or restore sediment storage capacity. • Maintain and restore water quality by cleaning ditches or structures. • Reduce flooding and erosion from blockages of system by removing obstructions such as debris, trash, yard waste, and/or sediment.
		Deposition of Large Woody Debris	Not Applicable	Not Applicable
		Removal of Large Woody Debris	Not Applicable	Not Applicable
		Temporary Water Diversion	Mobilize sediments, temporary fish passage impediment	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
	Vegetation Modification	Long Term Removal of Vegetation	Increase erosion rates & sedimentation	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Provide a safe roadway surface for traveling public. • Reduce the occurrence of vehicles leaving the road surface and entering sensitive areas.
		Permanent Removal of Vegetation	Increase erosion rates & sedimentation, elimination of normal forest succession processes	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Provide a safe roadway surface for traveling public. • Reduce the occurrence of vehicles leaving the road surface and entering sensitive areas.
		Planting Vegetation	Buffer riparian zone, decrease erosion rates	• Protect Watercourse, stream and/or waterbody. • Maximize opportunities for increased infiltration. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Reduce turbidity. • Allow infiltration of water.
		Short Term Removal of Vegetation	Increase erosion rates & sedimentation	• Protect Watercourse, stream and/or waterbody. • Maximize opportunities for increased infiltration. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Reduce turbidity. • Allow infiltration of water.
	Paving	Addition of Impervious Surface	Increase erosion rates & sedimentation, prevent revegetation	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Maintenance of existing		• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Provide a safe roadway surface for traveling public. • Minimize pollutants resulting from vehicle accidents such as petroleum hydrocarbons, heavy metals, and road washoff from entering storm drainage/stream system. • Reduce the occurrence of vehicles leaving the road surface and entering sensitive areas. • Control sediment and debris from ROW.
	Chemical	Fuel & Industrial Fluids Present	Release pollutants	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Painting	Release pollutants	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Uncured Concrete, Hot Asphalt or Hot Tar Used	Release pollutants	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
Adjacent to or Above Stream (within 300 ft)	Earth/Surface or cleaning Work	Clearing, Drilling, Excavation, Filling, Grading & Grubbing	Mobilize sediments, Increase erosion rates	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Maintain and restore structure. • Reduce sediment conveyance and loading to watercourses and/or streams by trapping and removal of sediment and/or debris. • Reduce or trap sediments in gravel. • Allow infiltration of water through gravel. • In areas where open ditch sections abut the roadway, provide a filter strip for runoff before water enters the ditch using gravel and vegetation on the roadway shoulder, if area is wide enough. • Clean roadway surface and remove soil, organics, solid waste and debris from entering watercourses, streams and/or water bodies. • Restore or maintain surface water drainage by cleaning curbs and drain inlets. • Reduce sediment loading of shoulders, ditches, detention ponds and watercourses and/or streams. • Provide a safe roadway surface for traveling public. • Reduce the occurrence of vehicles leaving the road surface and entering sensitive areas. Control sediment and debris from ROW.
		Heavy Equipment Present	Soil compaction, mobilize sediments, Increase erosion rates	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. Minimize work site pollutants from maintenance / repair activities.
		Shore Defense Works	Mobilize sediments, Increase erosion rates, reduce gravel recruitment	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Improve or maintain riparian habitat. • Reduce streambed/streambank erosion by re-vegetation or stabilization of disturbed soils. • Remove soil, organics, solid waste, and debris from entering watercourses, streams and/or water bodies. • Reduce sediment loading of shoulders, ditches, detention ponds and watercourses and/or streams. • Provide a reasonable safe roadway surface for traveling public. • Minimize pollutants resulting from vehicle accidents such as petroleum hydrocarbons, heavy metals, and road washoff from entering storm drainage/stream system. • Reduce the occurrence of vehicles leaving the road surface and entering sensitive areas. • Control sediment and debris from ROW. • Stabilize slide/washout area within the ROW to reduce environmental, transpiration and/or structural impacts.
	Hydraulic Modification	Channelization or Diking	Mobilize sediments, harden banks, decrease sinuosity, prevent re-vegetation, remove existing in-stream complexity, alter hydraulics and flow regime, elimination of channel migration, and reduce instream habitat complexity	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. Reduce streambed/streambank erosion by revegetation or stabilization of disturbed soils. • Reduce flooding and erosion from blockages of system by removing obstructions such as debris, trash, yard waste, sediment.
		Culvert Cleaning	Mobilize sediments	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Maintain or restore structure. • Minimize work site pollutants from maintenance/repair activities. • Restore or maintain surface water drainage by performing repairs. • Restore or maintain road surface/safety. • Reduce turbidity. • Reduce sediment conveyance and loading to watercourses and/or streams by trapping and removal of sediment and/or debris from the system. • Clean up and remove sediment from drainage system. • Reduce potential plugging of systems. • Reduce overflows/flooding from plugged system. • Maintain and restore water quality by cleaning ditches or structures. • Keep structure clear of debris, trash, and yard waste. • Maintain and restore water quality by cleaning ditches and/or stormwater facilities which are watercourses or streams. • Improve or maintain fish passage. • Improve or maintain streambed habitat within pipe, culvert, or area within work zone. • Reduce flooding and erosion from blockages of system by removing obstructions such as debris, trash, yard waste, sediment. • Remove soil, organics, solid waste and debris from entering watercourses, stream and/or water bodies. • Reduce sediment loading of shoulders, ditches, detention ponds and watercourses and/or streams. Control sediment and debris from ROW.
		Culvert Extension, Reduction	Mobilize sediments	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Maintain or restore structure. • Minimize work site pollutants from maintenance/repair activities. Restore or maintain road surface/safety. • Improve or maintain streambed habitat within pipe, culvert or area within work zone. • Reduce streambed/streambank erosion by revegetation or stabilization of disturbed soils. • Reduce the occurrence of vehicles leaving the road surface and entering sensitive areas. • Repair roadways, surface drainage, stormwater system, and/or other ROW structures.
		Culvert Replacement	Mobilize sediments	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Maintain or restore structure. • Minimize work site pollutants from maintenance/repair activities. • Restore or maintain road surface/safety. • Improve or maintain streambed habitat within pipe, culvert or area within work zone. • Reduce streambed/streambank erosion by revegetation or stabilization of disturbed soils. • Improve or maintain fish passage. • Improve or maintain riparian habitat.
		Enclosed Drainage System Cleaning	Mobilize sediments	• Protect Watercourse, stream and/or waterbody. • Reduce worksite pollutants to maintain or restore water quality. • Control storage, delivery, and routing of surface and groundwater, to control volumes and velocities of stormwater discharge by removing sediments. • Reduce sediment transport from system breaks by cleaning. • Maintain or restore structure. • Minimize work site pollutants from maintenance/repair activities. • Restore or maintain surface water drainage by performing repairs. • Reduce turbidity. • Reduce sediment conveyance and loading to watercourses and/or streams by trapping and removal of sediment and/or debris from the system. • Clean up and remove sediment from drainage system. • Reduce potential plugging of systems. • Reduce overflows/flooding from plugged system. • Maintain and restore water quality by cleaning ditches or structures. • Maintain or restore sediment storage capacity. • Keep structure clear of debris, trash, and yard waste. • Maintain and restore water quality by cleaning ditches and/or stormwater facilities which are watercourses or streams. • Improve in-stream bio-filtration. • Reduce flooding and erosion from blockages of system by removing obstructions such as debris, trash, yard waste, and sediment. • Remove soil, organics, solid waste and debris from entering watercourses, streams and/or water bodies. • Reduce sediment loading of shoulders, ditches, detention ponds, watercourses and/or streams. • Control sediment and debris from ROW. • Improve or maintain fish passage. • Improve or maintain streambed habitat within pipe, culvert or area within work zone.

Table 26: Mechanism of Effects and Potential Outcomes (Continued)

Maintenance Activity Proximity	Classification	Components	Mechanisms for Effects/Impacts	Effects with Program Potential Outcomes
		Deposition of Large Woody Debris	Mobilize sediments	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Improve or maintain streambed habitat within pipe, culvert or area within work zone.
		Removal of Large Woody Debris	Mobilize sediments, remove existing in-stream complexity.	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Temporary Water Diversion	Mobilize sediments, temporary fish passage impediment	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Minimize work site pollutants from maintenance/repair activities.
	Vegetation Modification	Long Term Removal of Vegetation	Loss of shade, increase erosion rates & sedimentation, destabilization of streambank, reduced LWD recruitment	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Permanent Removal of Vegetation	Loss of shade, increase erosion rates & sedimentation, destabilization of streambank, reduced LWD recruitment	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Planting Vegetation	Mobilize sediments, buffer riparian zone, decrease erosion rates	• Protect Watercourse, stream and/or waterbody. • Maximize opportunities for increased infiltration. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Improve in-stream bio-filtration. • Improve or maintain riparian habitat. • Reduce streambed/streambank erosion by revegetation or stabilization of disturbed soils.
		Short Term Removal of Vegetation	Loss of shade, increase erosion rates & sedimentation	• Protect Watercourse, stream and/or waterbody. • Maximize opportunities for increased infiltration. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Improve in-stream bio-filtration. • Improve or maintain riparian habitat. • Reduce streambed/streambank erosion by revegetation or stabilization of disturbed soils.
	Paving	Addition of Impervious Surface	Increase erosion rates & sedimentation, prevent revegetation	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Minimize work site pollutants from maintenance/repair activities. • Restore or maintain road surface/safety. • Provide a reasonable safe roadway surface for traveling public. • Minimize pollutants resulting from vehicle accidents such as petroleum hydrocarbons, heavy metals, and road washoff from entering storm drainage/stream system. • Reduce the occurrence of vehicles leaving the road surface and entering sensitive areas. • Repair roadways, surface drainage, storm water system, and/or other ROW structures.
		Maintenance of existing		• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Provide a reasonable safe roadway surface for traveling public. • Minimize pollutants resulting from vehicle accidents such as petroleum hydrocarbons, heavy metals, and road washoff from entering storm drainage/stream system. • Reduce the occurrence of vehicles leaving the road surface and entering sensitive areas. • Control sediment and debris from ROW.
	Chemical	Fuel & Industrial Fluids Present	Release pollutants	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		High Pressure Washing/Flushing	Release pollutants	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Painting	Release pollutants	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Uncured Concrete, Hot Asphalt or Hot Tar Used	Release pollutants	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
Instream	Earth Work	Drilling, Excavation, & Filling	Mobilize sediments, alter stream hydraulics	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Maintain and restore structure. • Reduce sediment conveyance and loading to watercourses and/or streams by trapping and removal of sediment and/or debris. • Reduce or trap sediments in gravel. • Allow infiltration of water through gravel. • In areas where open ditch sections abut the roadway, provide a filter strip for runoff before water enters the ditch using gravel and vegetation on the roadway shoulder, if area is wide enough. • Clean roadway surface and remove soil, organics, solid waste and debris from entering watercourses, streams and/or water bodies. • Restore or maintain surface water drainage by cleaning curbs and drain inlets. • Reduce sediment loading of shoulders, ditches, detention ponds and watercourses and/or streams. • Provide a reasonable safe roadway surface for traveling public. • Reduce the occurrence of vehicles leaving the road surface and entering sensitive areas. • Control sediment and debris from ROW.
		Heavy Equipment Present	Soil compaction, mobilize sediments, alter stream hydraulics	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Manual Labor Present	Mobilize sediments, alter stream hydraulics	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Shore Defense Works	Mobilize sediments, alter stream hydraulics	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. Improve or maintain riparian habitat. Reduce streambed/streambank erosion by re-vegetation or stabilization of disturbed soils. Remove soil, organics, solid waste, and debris from entering watercourses, streams and/or water bodies. Reduce sediment loading of shoulders, ditches, detention ponds and watercourses and/or streams. Provide a reasonable safe roadway surface for traveling public. Minimize pollutants resulting from vehicle accidents such as petroleum hydrocarbons, heavy metals, and road washoff from entering storm drainage/stream system. Reduce the occurrence of vehicles leaving the road surface and entering sensitive areas. Control sediment and debris from ROW. Stabilize slide/washout area within the ROW to reduce environmental transportation and/or structural impacts.
	Hydraulic modification	Channelization or Diking	Mobilize sediments, harden banks, decrease sinuosity, prevent re-vegetation, remove existing in-stream complexity, alter hydraulics and flow regime, elimination of channel migration, and reduce instream habitat complexity	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Maintain and restore structure. • Reduce streambed/ streambank erosion by revegetation or stabilization of disturbed soils. • Reduce flooding and erosion from blockages of system by removing obstructions such as debris, trash, yard waste and sediment.
		Culvert Cleaning	Mobilize sediments	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Maintain or restore structure. • Minimize work site pollutants from maintenance/repair activities. • Restore or maintain surface water drainage by performing repairs. • Restore or maintain road surface/safety. • Reduce turbidity. • Reduce sediment conveyance and loading to watercourses and/or streams by trapping and removal of sediment and/or debris from the system. • Clean up and remove sediment from drainage system. • Reduce potential plugging of systems. • Reduce overflows/flooding from plugged system. • Maintain and restore water quality by cleaning ditches or structures. • Keep structure clear of debris, trash, and yard waste. • Maintain and restore water quality by cleaning ditches and/or stormwater facilities which are watercourses or streams. • Improve or maintain fish passage. • Improve or maintain streambed habitat within pipe, culvert or area within work zone. • Reduce flooding and erosion from blockages of system by removing obstructions such as debris, trash, yard waste, sediment. • Remove soil, organics, solid waste and debris from entering watercourses, stream and/or water bodies. • Reduce sediment loading of shoulders, ditches, detention ponds and watercourses and/or streams. Control sediment and debris from ROW.
		Culvert Extension and Reduction	Mobilize sediments, alter stream hydraulics	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Maintain or restore structure. • Minimize work site pollutants from maintenance/repair activities. Restore or maintain road surface/safety. - Improve or maintain fish passage. • Improve or maintain riparian habitat. • Improve or maintain streambed habitat within pipe, culvert or area within work zone. • Reduce streambed/streambank erosion by revegetation or stabilization of disturbed soils. Reduce the occurrence of vehicles leaving the road surface and entering sensitive areas. • Repair roadways, surface drainage, storm water system, and/or other ROW structures.
		Culvert Replacement	Mobilize sediments, alter stream hydraulics	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Improve or maintain fish passage. • Improve or maintain riparian habitat. • Improve or maintain streambed habitat within pipe, culvert or area within work zone.
		Enclosed Drainage System Cleaning	Not Applicable	Not Applicable
		Deposition of Large Woody Debris	Mobilize sediments, alter hydraulics, increase habitat complexity	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Improve or maintain streambed habitat within pipe, culvert or area within work zone.
		Removal of Large Woody Debris	Mobilize sediments, alter hydraulics, decrease habitat complexity	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Temporary Water Diversion	Instream habitat displacement, alter stream hydraulics, barrier to passage	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality. • Minimize work site pollutants from maintenance/repair activities.
	Structure Work	Barge Present	Mobilize sediments, alter stream hydraulics	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Bridge Debris Removal	Mobilize sediments, alter stream hydraulics	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Falsework, Cofferdam, or Other Temporary Structure Placement	Instream habitat displacement, alter stream hydraulics, barrier to passage	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Pier, Footing, or Abutment or Scour	Instream habitat displacement, alter stream hydraulics, barrier to passage	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.

Table 26: Mechanism of Effects and Potential Outcomes (Continued)

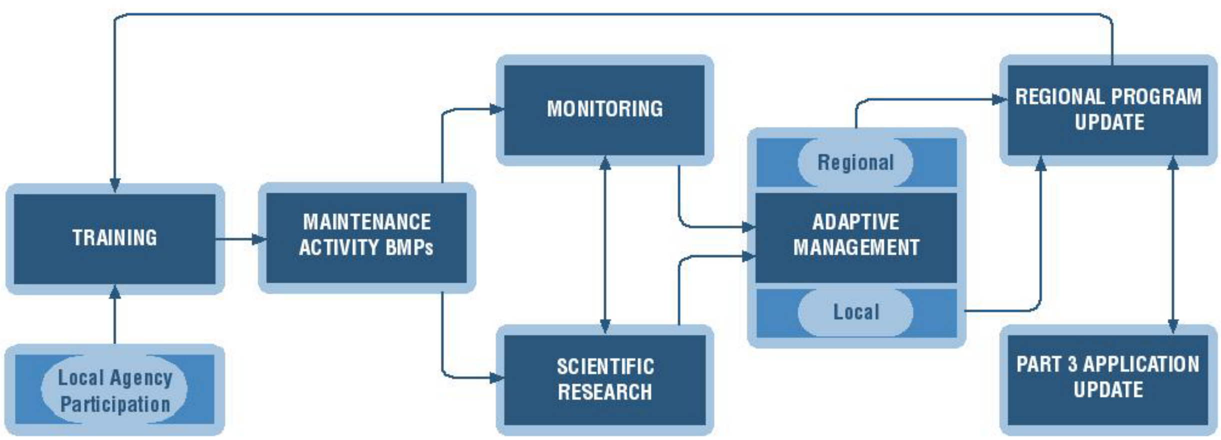
Maintenance Activity			Mechanisms for Effects/Impacts	Effects with Program
Proximity	Classification	Components		Potential Outcomes
	Chemical	Fuel & Industrial Fluids Present	Release pollutants	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		High Pressure Washing	Release pollutants	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Uncured Concrete Used	Release pollutants	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.
		Treated Woods (Instream only)	Release pollutants	• Protect Watercourse, stream and/or waterbody. • Reduce runoff (of dirt, debris, sediment, and petroleum products) from Maintenance Activity to contribute to the restoration of water quality.

6.4 Regional Program Elements 1-9

The overall impact of the Regional Program is to conserve habitat and contribute to PFC while performing road maintenance activities. Although the risk of adverse habitat impacts from road maintenance is slight and likely to occur on a one-time or infrequent basis, the Regional Forum recognized that risk and has built in a method to improve BMPs over time, to avoid errors or BMP failures, and to minimize impacts if errors or failures occur.

This corrective action is accomplished by combining Program Elements 1 – 9 with Program Element 10, BMPs and Conservation Outcomes. These other elements help to minimize the risk of adverse habitat impact. As shown in Figure 8, these program elements form an integrated process of training, monitoring, and adaptive management that tracks the effectiveness of maintenance BMPs and improves practices as needed.

Figure 8. Avoiding or Minimizing Adverse Impacts



6.4.1 Training

The first step in minimizing the risk of take is through a comprehensive training program. Training provides the means of quickly responding to problems in the field to avoid or minimize habitat impact. Crewmembers and supervisors will receive appropriate training from instructors who have been trained in the Regional Program (see Program Element 3 of the *Guidelines* for details). With appropriate training, field personnel will recognize when to use BMPs, problems with BMPs, and potential habitat risks. Training will also be given to engineering and environmental support staff to ensure that potential technical problems are dealt with in the planning stages of projects that require design or environmental support.

6.4.2 Monitoring

BMPs will be monitored for effectiveness during the course of maintenance activities. In cases where BMPs are needed after maintenance work is completed, monitoring will continue for those BMPs. If problems occur, actions such as correcting or adding BMPs will be taken to achieve outcome objectives.

6.4.3 Scientific Research

Scientific case studies and literature research will be conducted to achieve the desired BMP outcomes. Based on research findings, recommendations to modify Part 1 and/or Part 2 of the Regional Program will be presented to the Regional Forum.

6.4.4 Adaptive Management

In nearly all cases, conducting maintenance activities in compliance with the Regional Program contributes to conservation of the species. The Regional Program recognizes the potential for problems to occur during the course of maintenance activities, and has built an adaptive management process to address these concerns. The adaptive management process allows for local agencies as well as the Regional Forum to learn from experience in the field and scientific research to improve the program.

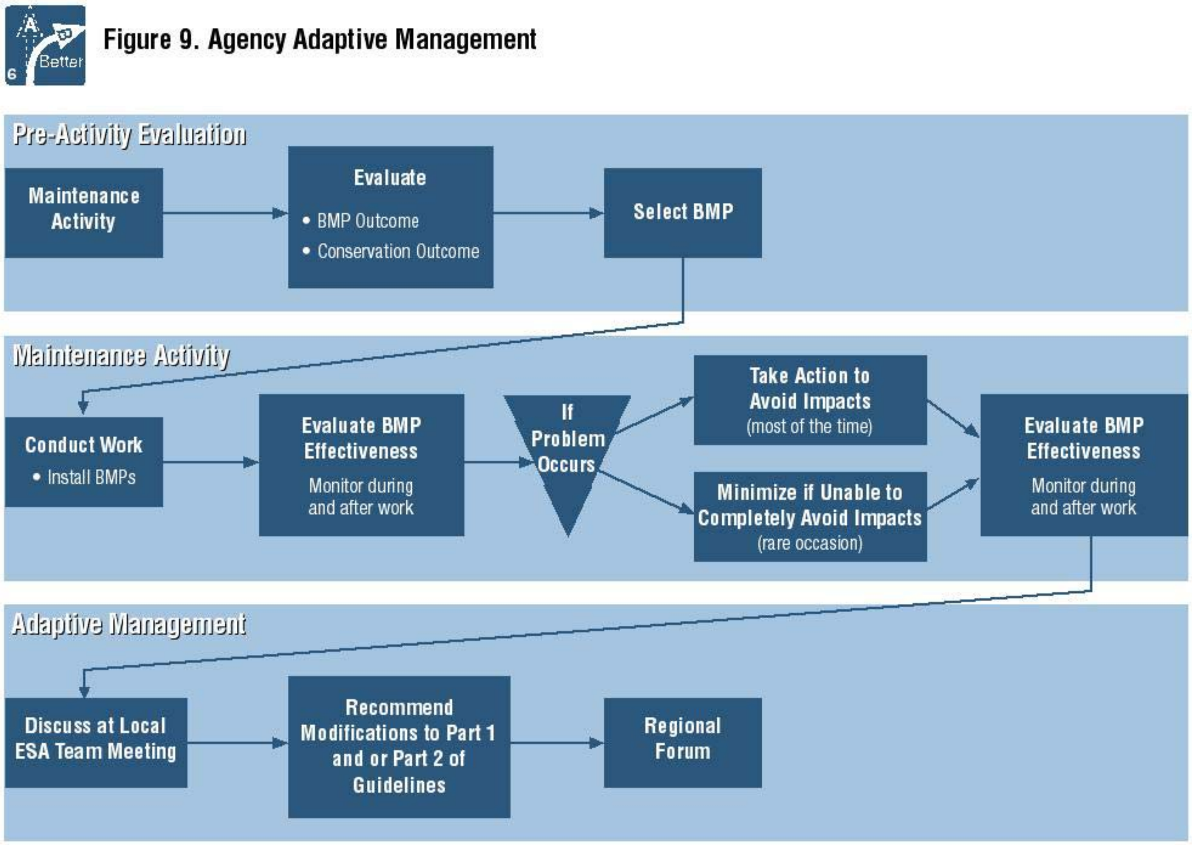
Adaptive management will occur at the local, agency, and regional levels. Local ESA teams and the Regional Forum will evaluate information gathered during the course of maintenance activities, BMP implementation, monitoring, and scientific research. Based on this evaluation, Part 3 Applications will be updated at the local level, and the Guidelines will be updated at a regional level.

6.4.4.1 Agency Adaptive Management

During road maintenance activities, countless combinations of conditions occur that affect BMP effectiveness. For this reason, the Regional Program is outcome-based. The outcome-based approach allows road crews, supervisors, environmental staff, engineers, and others to respond to changing conditions at the work site to achieve specified BMP outcomes.

In spite of the outcome-based approach, on rare occasions problems will occur at the worksite, reducing BMP effectiveness. When this occurs, agency adaptive management will be employed to avoid or minimize potential adverse impacts to habitat. There are three phases to the agency adaptive management process:

- The pre-activity evaluation
- The maintenance activity
- Adaptive management.



Pre-Activity Evaluation
Prior to starting work, the site is evaluated to determine appropriate maintenance activities and BMPs. Maintenance activities are selected to achieve the following two goals:

1. Maintaining/repairing the ROW structure
2. Providing mitigation for the original construction of the ROW structure.

BMPs are selected to achieve the outcomes prescribed in the Regional Program, thus avoiding/minimizing adverse impacts and contributing to PFC.

Maintenance Activity
Local ESA teams will be formed in each agency as defined in their Part 3 Application. Whenever corrective actions are taken, the local ESA team will evaluate the actions and their effectiveness.

During the course of maintenance activities, BMPs are installed and monitored. BMP monitoring occurs both during and after the maintenance activity itself to achieve effectiveness. If a problem occurs, corrective action will be taken to avoid impacts and to achieve BMP outcomes. Usually, actions involve installing additional BMPs which, in combination with the initial BMPs, will achieve the prescribed BMP outcome.

In nearly all situations, it will be possible to correct problems as they arise. On rare occasions, however, adverse impacts could occur. In nearly all cases, these will be temporary impacts, lasting only until a combination of BMPs is installed to correct the problem.

Adaptive Management

Based on the local ESA team's evaluations, recommendations for modifications to Part 1 and/or Part 2 of the Regional Program will be forwarded to the Regional Forum for consideration per the Agency Adaptive Management process shown in Figure 9.

6.4.4.2 Regional Adaptive Management

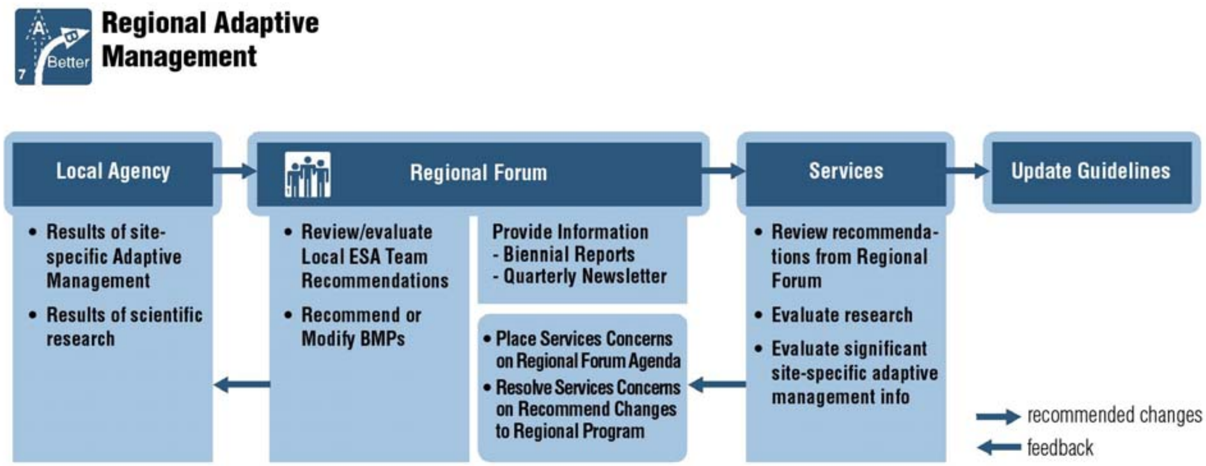
Adaptive management is key to the success of the Regional Program. Adaptive Management provides a means of improving conservation outcomes in 3 ways:

1. Improving site specific outcomes at the local level.
2. Improving the Regional Program at the regional level.
3. Avoiding and minimizing potential adverse impacts by sharing information at the regional level.

Recommendations from local ESA teams are evaluated in the Regional Forum meetings. Additionally, Regional Forum members evaluate the result of local agency scientific research. Based on this evaluation, the Regional Forum produces recommended program changes, which are submitted to NMFS for final review and approval.

If NMFS has questions or concerns, these are sent to the Regional Forum for resolution. Final program changes, as approved by NMFS, are then used to update the Regional Program (Figure 10).

Figure 10. Regional Adaptive Management Process.



6.5 Adverse Effects

As shown in Table 24, some classifications of maintenance activities have the potential to degrade baseline indicators.   The Regional Program's adaptive management process was designed to avoid and minimize occurrences of adverse habitat impacts. The potential adverse impacts from road maintenance, although small in scale, must be clearly and thoroughly evaluated. Those impacts can occur during these classifications of work:

- Earth/surface or cleaning work
- Hydraulic modification
- Vegetation modification.
- Paving/asphalt and concrete

Following is a description of the potential adverse impacts shown in Table24, together with a detailed description of how the Regional Program avoids and minimizes these impacts.

6.5.1 Classification: Earth Surface or Cleaning Work

Component/Activity: Clearing, Drilling, Excavation, Filling, Grading, Grubbing, Cleaning, Grinding or Cutting

Implementation of the Regional Program minimizes potential adverse impacts due to earth/surface or cleaning work. If the Regional Program is not implemented, the activities of clearing, drilling, excavating, filling, grading, grubbing, cleaning, grinding or cutting in or adjacent to watercourses or streams has the potential to impact water quality and various habitat elements. The road maintenance activities that trigger this classification are shown in Table C-2. Each component/activity is listed in alphabetical order for easy reference. Most of these activities include all work necessary to maintain roadside ditches, culverts, catch basins, inlets, and detention/retention basins. These component/activities all function to keep the roadway free from excess water, which can create an unsafe condition or road failure.

Water quality impacts are the primary potential direct effect to aquatic species during ground-disturbing activities. These impacts occur through generation of sediment and side casting of windborne dust and paint particles. Clearing ditches, culverts, drainage systems and grading shoulders can dislodge sediment and expose soil allowing an increase of sediment transport during storm events. Because stormwater conveyance systems often discharge into waters of the state, the resultant temporary increase of sediment loads can adversely affect water quality in fish-bearing waters. Excess sediment loading and turbidity levels can clog gills of fish, smother eggs, embed spawning gravel, disrupt feeding and growth patterns of juveniles, delay upstream migration of adults, and scour nutrients from the stream substrate (Burton et al. 1990; Washington State Conservation Commission 1999).

Maintenance activities near streams could disturb fish and cause them to temporarily abandon suitable habitat. Disturbance can result from the presence of equipment and personnel in and near streams or from the use of artificial light during night work.

The use of gas and diesel-powered equipment creates a potential for accidental spills of toxic substances that can kill or injure fish. Spilling of petroleum products and other toxicants is not a regular occurrence during equipment operation. Impacts from petroleum spills have a low probability of occurrence when following the spill prevention and control BMPs.

Finally, if the Regional Program is not implemented, maintenance activities may adversely impact riparian vegetation. Impacts to riparian habitat can occur from grading at storm outfalls and during the removal of debris along ditches and at outfalls. These activities could result in the loss of minor amounts of riparian vegetation. Such impacts could affect fish food resources, reduce cover habitat, reduce LWM recruitment, increase sedimentation, and increase water temperature.

Drainage system maintenance and repair activities often improve stormwater conveyance. Understanding the movement of pollutants from vehicles to roads, and from roads to waterbodies is necessary to protect aquatic habitat and nearby surface water. Pollutants such as those shown in Table 28 can be deposited on roads and surrounding ROW as shown on Figure 11. Traffic on roadways is the source of various pollutants, including vehicle exhaust of gases and liquids and release of wear products from both vehicles and road pavements. Therefore, without any other maintenance activities, pollutants from vehicles would likely accumulate until washed from roadways and into receiving waterbodies when it rains or snows.

Figure 11. Pollutant Containment and Removal Points

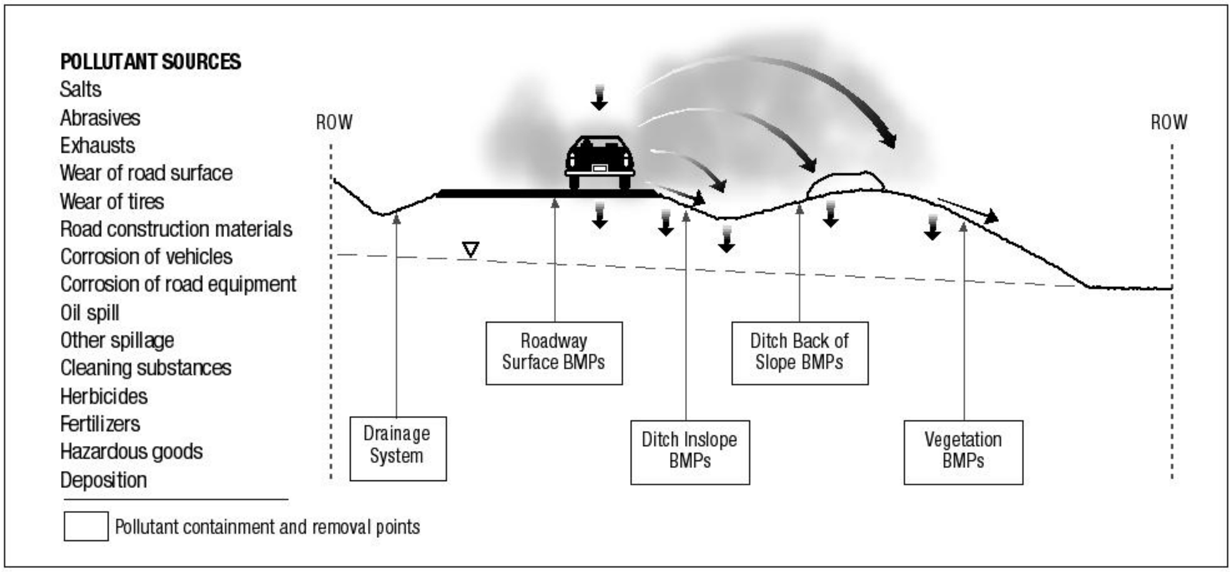


Table 28. Sources of Metals from Roads[9]

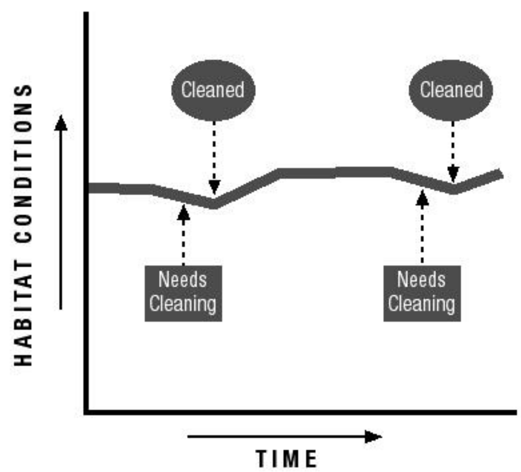
Metal	Source
Mg	Gasoline, and pavement
Al	Studs
Ti	Paint
V	Pavement (asphalt and ballast), vehicle corrosion, corrosion of metal plating, and lubricating oil
Cr	Brake lining, tires, studs, vehicle corrosion, asphalt, vehicle paint, and corrosion of metal plating
Mn	Pavement, brakes, gasoline
Fe	Vehicle corrosion, lamp-posts, railing, signs, brake lining, studs, gasoline, pavement, and paint
Co	Studs, vehicle corrosion, and tires
Ni	Brake lining, studs, asphalt, corrosion of vehicle, tires, gasoline, pavement, and corrosion of metal plating
Cu	Tires, studs, brake lines, radiator fluid, brake lining, brake shoe attrition, gasoline, and lubricating oil.
Zn	Vehicle corrosion, lamp-posts, railings, gasoline, tires, brake-lining, concrete, pavement, paint, and lubricating oil
Mo	Studs, and lubricating oil
Rh	Catalytic converter emissions
Pd	Catalytic converter emissions
Cd	Tires, studs, gasoline, diesel, and lubricating oil
Ce	Corrosion of vehicle, and corrosion of metal plating
W	Studs

9 *Source: Roth & Eklund 1999, Lindgren 1998, Bjekas & Lindmark 1994, Ward 1990, Amrhein & Strong 1990.

Pt	Catalytic converter emissions
Pb	Tires, brake lining, gasoline, asphalt, pavement, and paint

Maintenance of drainage systems prevents pollutants and sediment entrapped in stormwater facilities from entering surface or groundwater. Such maintenance is generally done by periodically cleaning out sediment and debris to ensure drainage systems and structures are functioning properly. Additionally, BMPs are used to reduce peak flows, to reduce runoff volumes, and to reduce the magnitude and concentration of constituents in runoff. Figure 12 shows how habitat is affected when enclosed drainage systems are cleaned:

Figure 12. Conceptual Model of Enclosed Drainage System Maintenance Process



BMPs to Avoid and Minimize Impacts from Earth/Surface or Cleaning work
Using a variety of BMPs during and after earth/surface or cleaning work will minimize potential impacts to fish, wildlife, and water quality. Eight BMP Outcome Categories can be used to minimize impacts to fish and wildlife during maintenance or repair activities. BMP outcome categories include: Keep Water from Work Area, Filter/Perimeter Protection, Reduce Potential for Soil Erosion, Settling, Habitat Protection/Maintenance, Reduce Contaminants Falling into Water, Reduce Water Velocity/Erosive Forces, and Containment. Part 1 BMPs includes selection and installation guidelines for the following BMPs: Disturbed Area, Equipment/Tools, Material/Debris Disposal, Spill Prevention and Control, Permits and Part 2 BMPs. The recommended BMPs are shown in Table 25.

The following are the conservation outcomes prescribed in the Regional Program for this kind of work: Minimize work site pollutants, Restore/maintain surface water drainage, Reduce turbidity, and Reduce sediment from entering watercourses or streams. See Part 2 of the *Guidelines* for detailed information on application of BMPs.

6.5.2 Classification: Earth/Surface or Cleaning Work

Component/Activity: Heavy Equipment Present
Performing maintenance will often involve the presence of heavy equipment. When the Regional Program is not implemented, the use of heavy equipment has the potential to impact water quality and various habitat elements. Water quality impacts may occur through the following: an increase in turbidity due to the disturbance of sediment during rock, mud, dirt and debris removal; repairs to bulkhead and dike structures; and placement of in-stream structures or riprap. Heavy equipment may also expose aquatic habitat to accidental spills of petrochemicals, lubricants, or antifreeze. Aquatic organisms may be impacted by an increase in noise and vibrations above ambient levels. If heavy equipment is introduced to an aquatic habitat during emergency actions, it may interfere with water flow in the system.

BMPs to Avoid and Minimize Impacts from Heavy Equipment
Several BMPs used while operating heavy equipment will minimize potential impacts to fish, wildlife, and water quality. BMPs can minimize impacts to fish and wildlife when heavy equipment is present: Disturbed Areas, Equipment/Tools Cleanup, Spill Prevention & Control, Material/Debris Disposal, Permits, Timing, and Pre-Activity. The recommended BMPs are shown in Table 25.

6.5.3 Classification: Earth Surface or Cleaning Work

Component/Activity: Shore Defense Works
Shore defense work involves repairing and stabilizing eroding banks on sections of rivers, streams, and lakes directly adjacent to existing roadways. Weather, flooding, or natural changes in the river or stream morphology often precipitate these events. In most cases, road maintenance activities do not involve construction of new shore defense structures, nor does maintenance work usually involve significant increases in shore defense areas. Most maintenance work involves repair or replacement of existing shore defense structures. Generally, new shore defense structures or significant increases in shore defense areas are part of CIPs. Some shore defense work involves federal permits, and thus, is covered under the ESA Section 7 review process. Shore defense work may also require HPAs from the WDFW, as well as other local permits and approvals. Compliance with any such permits and approvals is explicitly required in the Regional Program. Such permits include site-specific requirements to minimize adverse impacts.

In addition to site-specific permit requirements, implementation of the Regional Program minimizes potential adverse impacts due to shore defense works. If the Regional Program is not implemented, the performance of shore defense maintenance has the potential to impact water quality and various habitat elements.

Water quality impacts are the primary effects to aquatic species from shore defense work. The extent of the impacts will depend upon the location of the work in relation to the aquatic system. Depending on the time of year, shore defense work could result in impacts to individual fish and their habitat. Operation of heavy equipment and placement or dropping of materials within the stream can directly injure fish. Excess sediment loading and turbidity levels can clog gills of fish, smother eggs, embed spawning gravel, disrupt feeding and growth patterns of juveniles, delay up-stream migration of adults, and scour nutrients from the stream substrate (Burton et. Al. 1990; Washington State Conservation Commission 1999).

Shore defense work can result in temporary and permanent impacts to riparian habitat. Because many banks support riparian habitat, the work may result in impacts to riparian habitat. Shore work techniques typically affect vegetation, but revegetation is generally a requirement of this kind of work. Impacts to riparian habitat can temporarily or permanently reduce cover for fish and prey species, increase water temperature, and degrade water quality.

The use of gas and diesel-powered equipment in and near streams creates a potential for accidental spills of toxic substances that can kill or injure fish. Spilling of petroleum products and other toxicants is not a regular occurrence during equipment operation. Such impacts have a low probability of occurrence given training and spill kit requirements of the Regional Program.

Shore defense work may disturb fish and cause temporary abandonment of suitable habitat. The level of disturbance to aquatic species will vary depending on the extent and timing of the work. In-water work such as operation of heavy equipment is likely to cause the greatest disturbance to fish. However, noise and visual disturbance from the presence of equipment and personnel near aquatic areas may also affect fish distribution and movement patterns. Noises generated will likely exceed ambient levels in rural areas. This may temporarily affect fish distribution. In urban areas, noise generated from shore work may be similar to ambient noise levels and is less likely to affect fish.

BMPs to Avoid and Minimize Impacts from Shore Defense Work

Several BMPs used during and after shore defense work will minimize potential impacts to fish, wildlife, and water quality. Eight BMP Outcome Categories can be used to minimize impacts to fish and wildlife during maintenance or repair activities. BMP outcome categories include: Keep Water from Work Area, Filter/Perimeter Protection, Reduce Potential for Soil Erosion, Settling, Habitat Protection/Maintenance, Reduce Contaminants Falling into Water, Reduce Water Velocity/Erosive Forces, and Containment. Part 1 BMPs includes selection and installation guidelines for the following BMPs: Disturbed Area, Equipment/Tools, Material/Debris Disposal, Spill Prevention and Control, Permits and Part 2 BMPs. The recommended BMPs are shown in Table 25.

The following are the conservation outcomes prescribed in the Regional Program for this kind of work: Minimize work site pollutants, Restore/maintain surface water drainage, Reduce turbidity, and Reduce sediments from entering watercourses or streams. See Part 2 of the *Guidelines* for detailed information on application of BMPs.

Proper BMP installation and monitoring reduces the potential for pollutants and sediment to enter water bodies. The Regional Program also contains an adaptive management element that allows the program to be flexible. In the event a BMP is not achieving the desired outcome, adaptive management allows changes and/or modifications to BMPs so those outcomes can be met.

To avoid and minimize adverse impacts associated with shore defense work, the Regional Program offers impact reduction measures. Trees removed during clearing or slope stabilization activities may be donated for fish habitat restoration projects or placed in nearby aquatic systems to improve habitat complexity. When appropriate, shore defense plans may incorporate rootwads, logs, meanders and native re-vegetation into the stabilization project. Rootwads and logs within the bank will increase habitat complexity. Restoration of meanders may result in the creation of off-channel habitat. This change in sinuosity and complexity can improve habitat attributes such as hydro-geomorphology, vegetation, soil and water quality. Bioengineering and habitat restoration may result in reduced quantities of soil entering the system, reverse a degradation trend, and convert typical erosion sites into gravel deposition sites. Native re-vegetation of a stabilized area will increase habitat complexity, bio-filtration, shading, bank stabilization and promote macro-invertebrate population growth.

As a result of these actions, many impacts have been minimized. In the unlikely event of a BMP problem, water quality may be adversely affected if turbidity levels increase. Safeguards to reduce this problem are an integral component of the Regional Program. Crew training includes actions to minimize impacts if a BMP problem occurs.

6.5.4 Classification: Hydraulic Modification

Component/Activity: Channelization or Ditching
Implementation of the Regional Program minimizes potential adverse impacts due to channelization or ditching. If the Regional Program is not implemented, performance of channelization or ditching maintenance on or adjacent to watercourses or streams has the potential to impact water quality and various habitat elements.

Activities in this component include all work necessary to maintain roadside ditches and channels. All of these function to keep the roadway free from excess water that could create an unsafe condition. Regular maintenance is required to remove built-up sediment, debris or blockages, and to maintain capacity. Material that is removed is hauled to suitable disposal sites.

Water quality impacts from increased sediment are the most common adverse effects that can result from drainage and/or channel system maintenance and repair work. Cleaning of drainage and channel systems can dislodge sediment and expose soil allowing an increase of sediment transport during storm events. Because these systems often discharge into natural waters, the resultant temporary increase of sediment loads can adversely affect water quality in fish-bearing waters. Excess sediment loading and turbidity levels can clog gills of fish, smother eggs, embed spawning gravel, disrupt feeding and growth patterns of juveniles, delay up-stream migration of adults, and scour nutrients from the stream substrate.

Impacts to riparian habitat can occur from grading or pulling a ditch or removal of debris along ditches and at outfalls. These activities could result in the loss of minor amounts of riparian vegetation. Such impacts could affect fish food resources, reduce cover habitat, reduce LWM recruitment, increase sedimentation, and increase water temperature. However, channel and drainage system maintenance and repair activities often result in improvements to stormwater conveyance systems.

The use of gas and diesel-powered equipment creates a potential for accidental spills of toxic substances that can kill or injure fish. Spilling of petroleum products and other toxicants is not a regular occurrence during equipment operation. Because the Regional Program requires spill kits and training, such impacts have a low probability of occurrence.

Drainage and or channel maintenance and repair projects conducted near streams could disturb fish and cause temporary abandonment of suitable habitat during the work. The level of disturbance to aquatic species will vary depending on the extent and timing of activities. Visual disturbance from the presence of equipment and personnel is likely to have the greatest impact on fish. Because the duration of drainage and channel maintenance work is typically short, disturbance related impacts would be negligible.

BMPs to Avoid and Minimize Impacts from Channelization and Ditching
Several BMPs used during and after channelization and ditching work will minimize the potential impacts to fish, wildlife, and water quality. Eight BMP Outcome Categories can be used to minimize impacts to fish and wildlife during maintenance or repair activities. BMP outcome categories include: Keep Water from Work Area, Filter/Perimeter Protection, Reduce Potential for Soil Erosion, Settling, Habitat Protection/Maintenance, Reduce Contaminants Falling into Water, Reduce Water Velocity/Erosive Forces, and Containment. Part 1 BMPs includes selection and installation guidelines for the following BMPs: Disturbed Area, Equipment/Tools, Material/Debris Disposal, Spill Prevention and Control, Permits and Part 2 BMPs. The recommended BMPs are shown in Table 25, columns that are checked for channelization or diking rows.

The following are the conservation outcomes prescribed in the Regional Program for this kind of work: Minimize work site pollutants, Restore/maintain surface water drainage, Reduce turbidity, and Reduce sediment from entering watercourses or streams. See Part 2 of the *Guidelines* for detailed information on application of BMPs.

Proper BMP installation and monitoring efforts reduce the potential for pollutants and sediments from entering water bodies. Element 6 of the Regional Program allows adaptive management in the event a BMP is not achieving the desired outcome.

Channelization or ditching in or near watercourses or streams may also result in the alteration or loss of fish habitat. Habitat alterations could include the removal of snags and trees that could function as future LWM recruitment. Channelization or ditching may also alter aquatic, riparian and wetland habitats through a change in hydrology. Movement of in-stream gravel bars may occur due to changes in hydrodynamics and the associated potential impacts to spawning habitat. Channelization or ditching the banks of rivers and streams would result in fewer meanders within the system. This loss of complexity in systems can degrade hydro-geomorphology, vegetation, erosion/deposition, soil and water quality and may reduce creation of off-channel habitat.

To avoid and minimize these impacts, the Regional Program includes impact reduction measures. Trees removed during channelization or ditching activities may be donated for fish habitat restoration projects or placed in nearby aquatic systems to improve habitat complexity. Bioengineering and habitat restoration may result in reduced quantities of soil entering the system, reverse a degradation trend and convert typical erosion sites into gravel deposition sites. Native re-vegetation of a stabilized area will provide habitat complexity, biofiltration, shading, bank stabilization and future LWM recruitment.

As a result of these measures, most impacts are minimized. There is, however, the possibility of turbidity if BMPs fail or are not followed as outlined in the Regional Program. Safeguards to prevent problems are an integral component of the Regional Program. Crew training includes actions to minimize impacts if BMP problems occur.

6.5.5 Classification: Hydraulic Modification

Component/Activity: Removal of LWM

LWM would be removed only in rare instances where there is a safety hazard, such as debris built up against bridge abutments or landslides. During the course of an average annual maintenance program, it is far more likely that LWM would be placed as required by state and local permits, rather than removed for other reasons. Since there are, however, instances where road crews must remove LWM for safety reasons, this activity is discussed below.

If the Regional Program was not implemented, removal of LWM in or adjacent to watercourses or streams has the potential to impact water quality and various habitat elements. Repair/maintenance work that removes or disturbs materials in or adjacent to watercourses and/or streams may temporarily impact water quality. Material disturbance can potentially cause a release or increase of turbidity, sediment, gravel, rocks, nutrients, bacteria, oxygen demanding materials, heavy metals, petroleum hydrocarbons, synthetic organics and other solids. Depending on the time of year, excess sediment loading and high turbidity levels could impact redds, smothering eggs with fine sediment and reduced water circulation. All life stages of resident and anadromous fish could be impacted by sub-lethal conditions including: the disruption of feeding; attenuated growth patterns of juveniles; or delaying the upstream migration of adults.

Maintenance work activities can have noise levels above ambient conditions or increase light at night. Detour routes may result in concentrated traffic volumes and increased human access to aquatic habitats may impact aquatic organisms.

BMPs to Avoid and Minimize Impacts from Removal of LWM
Using a variety of BMPs during and after removing LWM will minimize potential impacts to fish, wildlife, and water quality. Eight BMP Outcome Categories can be used to minimize impacts to fish and wildlife during maintenance or repair activities. BMP outcome categories include: Keep Water from Work Area, Filter/Perimeter Protection, Reduce Potential for Soil Erosion, Settling, Habitat Protection/Maintenance, Reduce Contaminants Falling into Water, Reduce Water Velocity/Erosive Forces, and Containment. Part 1 BMPs includes selection and installation guidelines for the following BMPs: Disturbed Area, Equipment/Tools, Material/Debris Disposal, Spill Prevention and Control, Permits and Part 2 BMPs. The recommended BMPs are shown in Table 25.

The following are the conservation outcomes prescribed in the Regional Program for this kind of work: Minimize work site pollutants, Restore/maintain surface water drainage, Reduce turbidity, and Reduce sediment from entering watercourses or streams. See Part 2 of the *Guidelines* for detailed information on application of BMPs.

LWM removal in or adjacent to watercourses or streams may also result in temporary or permanent loss or alteration of fish habitat and loss of individual fish during removal of structures. LWM removal may also change hydrology, which in turn, may alter aquatic, riparian and wetland habitats. LWM removal may contribute to a decrease in stream sinuosity and complexity, which can lead to the further degradation of hydro-geomorphology, vegetation, erosion/deposition, soil and water quality. Movement of in-stream gravel bars may occur due to changes in hydrodynamics and the associated potential impacts to spawning habitat. LWM removal in watercourses and/or streams may result in a decrease in refuge and rearing habitat, a decrease in substrate for macro-invertebrate colonization and an increase in temperature of the immediate area. If the LWM removal results in fish passage improvements, there may be an increase in spawning and rearing habitat for anadromous and resident fish. Native re-vegetation of the stabilized area will provide and increase in habitat complexity, biofiltration, shading, bank stabilization and promote macro-invertebrate population growth.

As a result of these measures, many impacts are minimized. There is, however, the possibility of turbidity impacts if BMPs fail or are not followed as outlined in the Regional Program. Safeguards, such as crew training, include actions to minimize impacts if BMP problem occurs.

6.5.6 Classification: Hydraulic Modification

Component/Activity: Temporary Water Diversion (including the use of cofferdam or other temporary structure placement)

When conducting work, such as culvert replacement, in watercourses or streams, it is frequently necessary to place temporary water diversions to minimize impacts on aquatic habitat. Generally, such diversions are installed as required by state and local permits. Nearly always, work requiring temporary water diversions require an HPA from the WDFW, as well as other local permits and approvals. These permits and approvals are explicitly required in the Regional Program and include stringent site-specific requirements to minimize adverse impacts.

If the Regional Program is not implemented, temporary water diversions in or adjacent to watercourses or streams may briefly impact water quality and various habitat elements. Water diversion and temporary structure work will create a physical barrier to migrating aquatic vertebrates. The maintenance/repair work on these structures could result in an increase in turbidity during in-water work and the use of these structures in maintenance work may cause an increase in sedimentation during placement of in-stream structures. Poor placement of equipment in or around riparian habitat may erode streambanks. Inadequately following fish exclusion protocols may result in the loss of individual fish. Finally, watercourses or streams may be exposed to accidental spills of petrochemicals from equipment such as pumps.

BMPs to Avoid and Minimize Impacts from Hydrualic Modification

Using BMPs during and after temporary water diversion (including the use of cofferdam or other temporary structure placement) will minimize potential impacts to fish, wildlife, and water quality. Eight BMP Outcome Categories can be used to minimize impacts to fish and wildlife during maintenance or repair activities. BMP outcome categories include: Keep Water from Work Area, Filter/Perimeter Protection, Reduce Potential for Soil Erosion, Settling, Habitat Protection/Maintenance, Reduce Contaminants Falling into Water, Reduce Water Velocity/Erosive Forces, and Containment. Part 1 BMPs includes selection and installation guidelines for the following BMPs: Disturbed Area, Equipment/Tools, Material/Debris Disposal, Spill Prevention and Control, Permits and Part 2 BMPs. The recommended BMPs are shown in Table 25 under "Temporary Water Diversion" and "Falsework, Cofferdam, or other Temporary Structure Placements."

The following are the conservation outcomes prescribed in the Regional Program for this kind of work: Minimize work site pollutants, Restore/maintain surface water drainage, Reduce turbidity, and Reduce sediment from entering watercourses or streams. See Part 2 of the *Guidelines* for detailed information on application of BMPs.

Spill kits should be carried for small spills related to equipment problems. The Regional Program contains specific fish exclusion protocols to minimize fish impacts. These protocols contain information on procedures that should be used when dewatering a maintenance site.
As a result of these measures, impacts are minimized, but there remains the possibility petrochemicals and/or turbidity can enter the system if BMPs fail or are not followed as outlined

in the Regional Program. Safeguards to prevent problems are an integral component of the Regional Program, including crew training.

6.5.7 Classification: Vegetation Modification

Component/Activity: Long- and Short-term Removal of Vegetation
Implementation of the Regional Program minimizes potential adverse impacts due to long and short-term removal of vegetation. If the Regional Program is not implemented, the long and short-term removal of vegetation adjacent to watercourses or streams may impact water quality and various habitat elements. Vegetation removal may contribute to a decrease in stream sinuosity and complexity, which can lead to the further degradation of hydro-geomorphology, vegetation, erosion/deposition, soil and water quality. Movement of in-stream gravel bars may occur due to changes in hydrodynamics and the associated potential impacts to spawning habitat. Vegetation removal in watercourses and/or streams may decrease refuge and rearing habitat and substrate for macroinvertebrate colonization and increase temperature of the immediate area.

BMPs to Avoid and Minimize Impacts to Vegetation
Many BMPs during and after vegetation modification will minimize the potential impacts to fish, wildlife, and water quality. Eight BMP Outcome Categories can be used to minimize impacts to fish and wildlife during maintenance or repair activities. BMP outcome categories include: Keep Water from Work Area, Filter/Perimeter Protection, Reduce Potential for Soil Erosion, Settling, Habitat Protection/Maintenance, Reduce Contaminants Falling into Water, Reduce Water Velocity/Erosive Forces, and Containment. Part 1 BMPs includes selection and installation guidelines for the following BMPs: Disturbed Area, Equipment/Tools, Material/Debris Disposal, Spill Prevention and Control, Permits and Part 2 BMPs. The recommended BMPs are shown in Table 25.

The following are the conservation outcomes prescribed in the Regional Program for this kind of work: Minimize work site pollutants, Restore/maintain surface water drainage, Reduce turbidity, and Reduce sediment from entering watercourses or streams. See Part 2 of the *Guidelines* for detailed information on application of BMPs.

To avoid and minimize these impacts, the Regional Program presents impact reduction measures. Native re-vegetation of the stabilized area will provide an increase in habitat complexity, bio-filtration, shading, bank stabilization, and promote macro-invertebrate population growth. BMPs outlined in the Regional Program focus on the following outcomes: reduce erosion/sedimentation; contain pollutants; and where possible maximize habitat improvements. As a result of these measures, impacts are minimized. In the unlikely event of a BMP problem, water quality may be adversely affected if turbidity levels increase. Safeguards to prevent problems, including crew training in actions to minimize impacts, are an integral component of the Regional Program.

6.5.8 Classification: Paving/ Asphalt or Concrete

Component/Activity: Addition of Impervious Surface

In most cases, road maintenance activities do not increase impervious surface. Most maintenance work repairs or replaces existing impervious surface. Generally, significant increases in impervious surface within the ROW do not fall under the definition of maintenance. Projects that increase impervious surface are usually part of roadway CIPs. These types of projects may be federally funded or permitted which would fall under ESA Section 7 review. Under some circumstances, however, maintenance activities do increase impervious surface for safety reasons rather than to add capacity. Although the amount of impervious surface added is relatively small, some potentially adverse impacts to aquatic habitat are increased. The Regional Program addresses these circumstances.

Water quality impacts are the primary potential direct effect to aquatic species from new impervious surface. Clearing and grading near streams can result in increased sedimentation. Excess sediment loading and turbidity levels can clog gills of fish, smother eggs, embed spawning gravel, disrupt feeding and growth patterns of juveniles, delay up-stream migration of adults, and scour nutrients from the stream substrate (Burton et al. 1990; Washington State Conservation Commission 1999 through 2001). New impervious surface associated with maintenance work can result in increased levels of heavy metals, hydrocarbons, and other pollutants. Impervious surface can also result in stream temperature increases by creating less shaded conditions and increased solar exposure to surface water that otherwise would infiltrate or remain shaded beneath vegetation.

Maintenance work that adds new impervious surface near streams can also result in temporary and permanent impacts to riparian habitat. The creation of small amounts of impervious surface can result in encroachment of riparian vegetation. Impacts to riparian habitat can result in reduced cover for fish, a reduction in prey species, increased water temperature, and water quality degradation.

Such disturbances are likely to occur infrequently from maintenance work and safety improvements. Pavement work maintains the roadway in a safe operating condition, which minimizes the potential for accidents, thereby reducing the potential for spills into waters that support listed species.

BMPs to Avoid and Minimize Impacts from Addition of Impervious Surface

Employing a variety of BMPs during and after paving/asphalt or concrete work that increases the impervious surface will minimize the potential impacts to fish, wildlife, and water quality. Eight BMP Outcome Categories can be used to minimize impacts to fish and wildlife during maintenance or repair activities. BMP outcome categories include: Keep Water from Work Area, Filter/Perimeter Protection, Reduce Potential for Soil Erosion, Settling, Habitat Protection/Maintenance, Reduce Contaminants Falling into Water, Reduce Water Velocity/Erosive Forces, and Containment. Part 1 BMPs includes selection and installation guidelines for the following BMPs: Disturbed Area, Equipment/Tools, Material/Debris Disposal, Spill Prevention and Control, Permits and Part 2 BMPs. The recommended BMPs are shown in Table 25.

The following are the BMP outcomes prescribed in the Regional Program for this kind of work: Minimize worksite pollutants, Restore/maintain surface water drainage, Reduce turbidity, and Reduce sediments from entering watercourse or streams. See Part 2 of the *Guidelines* for detailed information on application of these BMPs

Completion of safety improvement activities may result in fewer accidents and fewer spills of hazardous substances such as oil, gas and antifreeze. Proper BMP installation and monitoring reduces the potential for pollutants and sediment from entering waterbodies. Information regarding BMP applications, limitations, construction guidelines, maintenance and removal is contained in Part 2 of the Regional Program.

In the unlikely event a BMP is not achieving the desired outcome, adaptive management (Program Element 6) allows changes and/or modifications to BMPs so those outcomes can be met.

6.5.9 Addressing Adverse Impacts

With implementation of BMPs, the risk of adverse habitat impacts from road maintenance is slight and likely to occur on a one-time or infrequent basis. The Regional Forum recognized that risk and has built in a method to improve BMPs over time to avoid occurrences of errors or BMP failures and to minimize impacts if errors or failures occur. This corrective action is accomplished by combining program elements 6, 7 and 8 with Program Element 10, BMPs and Conservation Outcomes. Monitoring, Scientific Research, and Adaptive Management all help to minimize the risk of adverse habitat impact. For that reason, it is a requirement that agencies adopt all 10 elements of the Regional Program to address potential adverse habitat impacts.

6.6 Beneficial Effects

Table 24 shows specific activities and effects that improve baseline conditions with implementation of the Regional Program. Implementation of the BMPs and conservation outcomes clearly contribute to PFC. This section describes, by maintenance category, the anticipated beneficial effects of the Regional Program.

6.6.1 Maintenance Category: Roadway Surface

Pavement preservation work maintains the roadway in a safe operating condition, which minimizes the potential for accidents, thereby reducing the potential for spills into waters that support listed species. Adaptive management allows for the addition of timing to avoid or anticipate storm events in the Roadway Surface category. This will address the temperature effect during large overlay projects. Proper BMP installation contains the worksite, reducing the potential for pollutants and sediment from entering water bodies. Post activity monitoring is done to evaluate whether BMPs continue to function properly until the area is once again stabilized.

6.6.2 Maintenance Category: Enclosed Drainage Systems

Maintaining enclosed drainage systems in accordance with the Guidelines leads to increased storage and treatment efficiency of stormwater systems, which, in turn, leads to long term water quality improvements. Implementing the *Guidelines* enclosed drainage system maintenance standards leads to the following beneficial effects:

- **Worksite Containment:** reduce the potential for sediment and contaminants to reach watercourses, streams and/or water bodies. Ongoing monitoring of BMPs is done to evaluate whether they continue to function properly until the area is stabilized.

- **Blockage Removal:** timely removal of blockages reduces potential for sediment and debris to adversely impact fish habitat.

- **Restoration of Flow Velocities/Volumes:** Cleaning of an enclosed drainage system allows the system to function properly, restoring flow volumes and velocities.

6.6.3 Maintenance Categories: Watercourses and Streams, Stream Crossings, and Bridge Maintenance

Maintenance work in watercourses and streams can have positive effects on habitat in a wide variety of ways. Changes in sinuosity and complexity in a system can contribute to PFC by improving habitat attributes such as hydro-geomorphology, vegetation, erosion/deposition, soil and water quality. Restoration of meanders may result in the creation of off-channel habitat; loss of meandering may reduce the creation of this kind of habitat.

In addition to the direct benefits of maintaining watercourses or streams in the ROW, implementing the *Guidelines* is expected to have the following beneficial effects:

- **Worksite Containment:** reducing the potential for sediment releases during the course of maintenance work in watercourses and streams. Ongoing monitoring of BMPs is done to evaluate whether they continue to function properly until the area is stabilized.
- **Blockage Removal:** Removing blockages and/or fish passage barriers provides access to additional habitat and prevents catastrophic ROW structure failure, which can have severe adverse habitat impacts.
- **Restoration of Flow Velocities/Volumes:** Flow velocities and volumes are addressed in the Regional Program by requiring appropriate system design for system repair or replacement, appropriate maintenance of existing systems, and removal of sediment or blockages.

- **Removal of Fish Passage Barriers:** Fish passage improvements will result in increased spawning and rearing habitat for anadromous and resident fish.
- **Revegetation:** Revegetation provides biofiltration, shading, habitat complexity and bank stabilization in riparian areas. It also promotes macroinvertebrate population growth. Bioengineering and habitat restoration can reverse a degradation trend and converts erosional sites into gravel deposition sites.
- **Permit Compliance:** The *Guidelines* specifically require compliance with regulations and permits. Permit requirements frequently accomplish several additional habitat improvements:
    - Some trees removed during clearing or slope stabilization activities may be donated for fish habitat restoration projects or placed in nearby aquatic systems to improve habitat complexity.
    - Permanent slope stabilization will result in reduced quantities of soil entering the system.
    - Potential creation of rearing habitat by increasing habitat complexity through incorporation of rootwads and LWM within the bank protection materials.
    - Incorporation of logs and similar in-stream structures (LWM) to increase habitat complexity.

6.6.4 Maintenance Category: Gravel Shoulders

Implementing the *Guidelines* when maintaining gravel shoulders has the potential for improving baseline conditions as follows:

- **Worksite Containment:** reducing the potential for sediment and contaminants to reach watercourses, streams and/or water bodies. Ongoing monitoring of BMPs, is done to evaluate whether they continue to function properly until the area is once again stabilized.
- **Infiltration:** Cleaning and maintaining roadway shoulders improves sheet flow and infiltration. This can be achieved by increasing opportunities for infiltration by placing gravel on the edge of the roadway. BMPs for open drainage system maintenance, such as grass lined ditches, also encourage infiltration and/or bio-filtration.

Addtionally, gravel shoulder maintenance may result in fewer accidents and thereby a reduction in spills of hazardous substances such as oil, gas, and antifreeze.

6.6.5 Maintenance Category: Street Surface Cleaning

Street surface cleaning removes large amounts of soil, organic material, other debris and pollutants before they enter watercourses, streams and other waterbodies.

6.6.6 Maintenance Category: Snow and Ice Control

Snow and ice control operations reduce vehicle accidents that may adversely impact aquatic habitat. Prompt removal of sand following snow events reduces sediment loading and preserves water quality.

6.6.7 Maintenance Category: Emergency Slide/Washout Repair

Slide and washout repair reduces silt and sediment from entering aquatic habitat. Projects that use bioengineering and habitat restoration can reverse a degradation trend and convert erosion sites into gravel deposition sites. When done in accordance with the *Guidelines*, slide and washout repair can achieve these conservation outcomes:

- **Chronic maintenance repair:** Frequent slide areas are the cause of chronic maintenance problems which contribute to chronic habitat degradation. To address this problem, the Regional Program commits implementing agencies to refer chronic maintenance and habitat problems to agency-specific CIP.
- **Worksite Containment:** reducing the potential for sediment and contaminants to reach watercourses, streams and/or water bodies. Ongoing monitoring of BMPs, is done to evaluate whether they continue to function properly until the area is once again stabilized.
- **Re-vegetation:** Re-vegetation provides bio-filtration, shading, habitat complexity and bank stabilization in riparian areas. It also promotes macro-invertebrate population growth. Bioengineering and habitat restoration can reverse a degradation trend, and converts erosional sites into gravel deposition sites.
- **Permit Compliance:** The *Guidelines* specifically require compliance with regulations and permits. Permit requirements frequently accomplish many additional habitat improvements:
    - Some trees removed during clearing or slope stabilization activities may be donated for fish habitat restoration projects or placed in nearby aquatic systems to improve habitat complexity.
    - Permanent slope stabilization will reduce quantities of soil entering the system.
    - Potential creation of rearing habitat by increasing habitat complexity through incorporation of rootwads and logs within the bank protection materials.
    - Incorporation of logs and similar in-stream structures to increase habitat complexity.

6.6.8 Maintenance Category: Concrete

The removal and repair of damaged concrete roadways, sidewalks, driveways, and curb and gutter sections are performed to provide a safe roadway and pedestrian traffic infrastructure and to maintain adequate conveyance of surface water to drainage systems. Maintenance activities may also involve the installation of new concrete structures.

BMPs proposed for concrete maintenance activities are designed to achieve the following habitat goal:

- Reduce pollutant runoff to restore water quality.
- Reduce velocities and allowing sheet flow when possible.
- Reduce worksite runoff to watercourses, streams and/or water bodies
- Maintain or restore the storage, delivery, and routing of surface and ground water
- Maintain or restore the storage area of sediments and other pollutants
- Remove sediment from system
- Protect water quality

6.6.9 Maintenance Category: Sewer

Sewer and storm systems are designed to efficiently collect and remove water from the ROW to permit the maximum use of the roadway, prevent damage to roadway structures, to protect abutting property from damages, and restore surface water drainage in combined sewer/storm systems. To maintain integrity of infrastructure and operational reliability the following systems are repaired, replaced, installed and maintained: treatment facilities; lift stations; pump stations; main lines; collection lines; trunk lines; interceptors; lake lines and storage/detention facilities.

BMPs proposed for sewer system maintenance activities are designed to achieve one or more of the following habitat goals:

- Protect watercourse and/or stream
- Reduce worksite pollutant to restore or maintain water quality
- Control the storage, delivery, and routing of surface and ground water to control volumes and velocities of stormwater discharge by repairing and maintaining sewer system
- System maintenance and repairs reduce sediment transport from system breaks
- Maximize opportunities for increased infiltration or biofiltration.

6.7 Maintenance Category: Water

Water system maintenance is conducted to maintain the integrity of the infrastructure, provide additional service and components, maintain operational reliability, and protect health and safety issues. Maintenance activities are performed on the operating components of the water system facilities including treatment plants, transmission mains, distribution lines, fire flow systems, reservoirs, tunnels and pump stations, meters, flushing, dewatering, services and associated ROWs or access.

BMPs proposed for water system maintenance activities are designed to achieve one or more of the following habitat goals:

- Protect watercourse and/or stream

- Reduce worksite pollutant to restore or maintain water quality
- Control the storage, delivery, and routing of surface and ground water to control volumes and velocities of stormwater discharge by restoring surface after installation, repair or replacement of underground piping
- System maintenance and repairs reduce sediment transport from system breaks
- Maximize opportunities for increased infiltration or bio-filtration where possible.

6.7.1 Maintenance Category: Vegetation

Vegetation is part of the ROW structure. Vegetation maintenance will be conducted in all roadway categories including roadway surface, open and closed drainage, sediment containment, water courses and streams, stream crossings, shoulders, and utilities. The purpose of vegetation maintenance is to promote, maintain, sustain, manage, or encourage vegetation growth within the ROW to comply with a variety of regulations and standards including public safety. Vegetation maintenance improves visibility, surface and subsurface drainage, fire and pollution control, and clear zone area.

BMPs proposed for maintaining vegetation are designed to achieve one or more of the following habitat goals:

- Improve drainage by reducing erosion
- Reduce the spread of noxious weeds and undesirable vegetation
- Limit erosion
- Increase bio-filtration
- Lower herbicide use
- Provide shading/reduce water temperature
- Provide habitat for macro-invertebrates.

7.0 Conclusion on Conservation

To qualify under limit 10 of the 4(d) Rule, routine road maintenance activities of any state, city, county or port must be consistent with conserving listed species. If a proposed road maintenance program preserves existing habitat function levels, and allows natural progression towards properly functioning condition (PFC), NMFS may determine that it conserves listed species and therefore qualifies under this limit.

To assist with this determination, the Biological Subcommittee of the Regional Forum working group prepared this BR. The BR assesses the effects of the Regional Program on indicators of salmonid habitat condition in Washington state by comparing the effects of the Regional Program with the effects of existing road maintenance on baseline habitat conditions (NMFS 1996). The BR concludes that routine road maintenance activities in Washington that conform with the Regional Program will not impair PFC, will not appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of impaired habitat toward PFC.

While routine road maintenance activities can contribute to the attainment and maintenance of PFC, some activities have the potential for adverse habitat effects. A range of BMP options were developed to minimize erosion and sedimentation, contain pollutants, and maximize habitat improvements. With the judicious use of these BMPs, any negative effects are expected to be temporary and offset by long-term benefits for salmonid habitat.

The short and long-term, cumulative and indirect effects of the proposed Regional Program maintenance activities and BMPs is shown in the following tables which are presented in Chapter 6.

Table 22:	**Program Activity Components**: outlines the maintenance activity components that are common to each maintenance category.
Table 23:	**Activities and indicators without Guidelines being implemented**: highlights the general effects of the maintenance activity components of the baseline indicators without BMPS: no effects, unknown effects, likely to degrade, and likely to restore. The effects listed are those thought to be primary and most likely to occur.
Table 24:	**Activities and Indicators with guidelines being implemented**: highlights the general effects of the maintenance activity components on the baseline indicators with BMPs: no effects, unknown effects, likely to degrade, and likely to restore. In many cases, alternative outcomes are also likely; for example, deposition of LWM could cause either an increase, or decrease, in sedimentation depending on the vantage point.
Table 25:	**Best Management Practices to Avoid And Minimize Impact**: identifies the recommended BMPs and subsequent conservation measures for likely to degrade baseline indicator maintenance activity components. These indicators, with the addition of the HPA, will change to a not likely to adversely affect determination. HPAs are issued by WDFW for activities that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state pursuant to Chapter 75.20 RCW. Each HPA is conditioned to avoid and/or mitigate impacts to fish life
Table 26:	**Mechanisms for effects**: illustrates how the primary effects of the Maintenance Activities and Effects on Baseline Indicators table are caused, in addition to potential outcomes within the Regional Program.

Table C.1:	**Baseline Indicator Levels**: a matrix that defines the levels of physical and biotic parameters (properly functioning, at risk, and not properly functioning) that may be influenced by human activities and that may also affect salmonids.
Table C.2:	**Common task descriptions for road maintenance:** a description of maintenance work activities and Primary Activity Components.

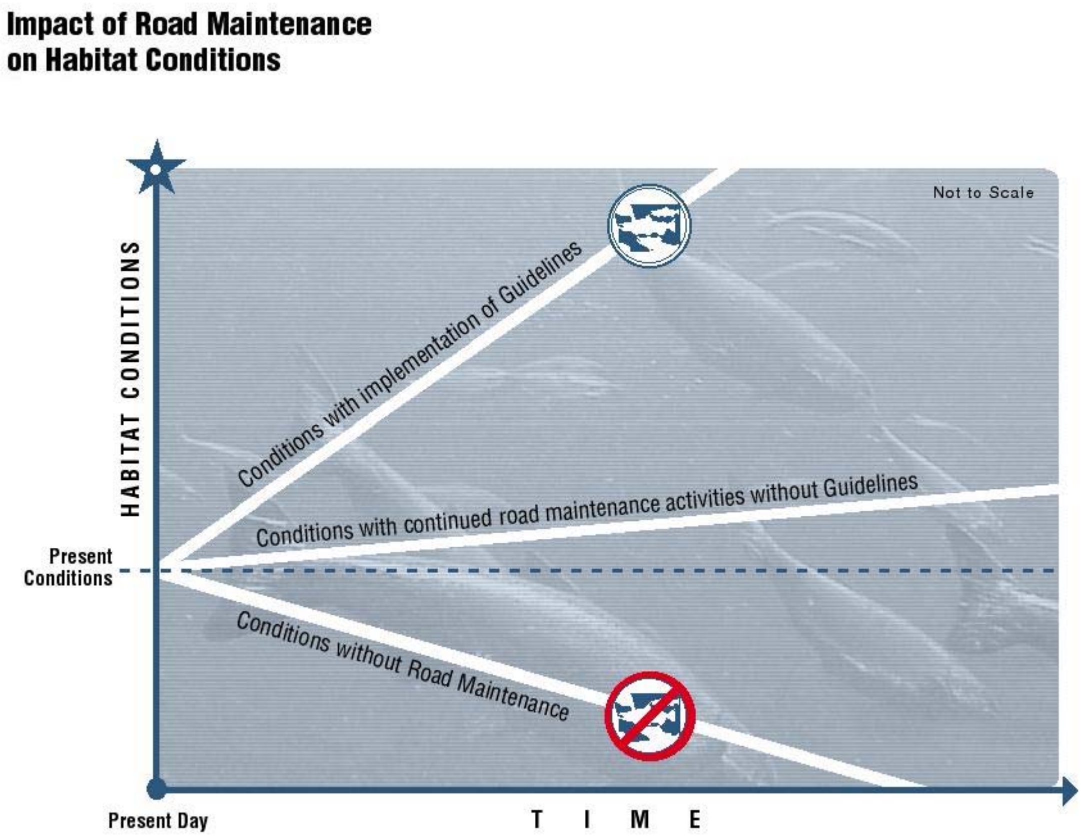
The BMPs provide a basis for concluding that any environmental effects of road maintenance are avoided, minimized, and mitigated. However, the main limitation of these BMPs is in ensuring that the proper BMP is selected, installed, appropriately maintained and monitored. Thus, in addition to the BMPs, the Regional Program consists of 9 other mandatory program elements. The following procedural elements provide a basis for concluding that the Regional Program will continue to improve in both substantive protection and quality of implementation:

- **Element 1. Regional Forum:** Sharing information regarding successful BMP applications in the field, together with scientific research, creates the potential for each agency to improve its contribution to conservation over time. Additionally, if a problem with program implementation occurs in one jurisdiction, this information sharing reduces repeated problems.
- **Element 2. Program Review and Approval:** The goal of the Program Review and Approval process is to establish consistency across the State so that conservation measures are achieved.
- **Element 3. Training:** Thorough training on all elements of the Regional Program, at applicable levels of implementing agencies, provides consistency across the State so that conservation goals can be met.
- **Element 4. Compliance Monitoring:** The objective of Compliance Monitoring is to evaluate program implementation to accomplish Regional Program conservation goals consistently across Washington
- **Element 5. Scientific Research:** Using information derived from field studies, literature research, and scientific research, as well as adaptive management conservation opportunities can be maximized.
- **Element 6. Adaptive Management:** Adaptive management provides a means by which conservation goals, management options, specific changes, and likely options for change are clearly identified and implemented.
- **Element 7. Emergency Response:** This program element allows for necessary emergency response measures, while keeping the Services and regulatory agencies apprised.
- **Element 8. Biological Data Collection:** This element includes habitat location information within the ROW and development of a process to train and alert staff where the *Guidelines* need to be applied.
- **Element 9. Biennial Reports:** The Regional Forum will provide biennial (every 2 years) reports to the Services. Biennial Reports will include a review of the 10

program elements, updates on research, recommended BMP changes, and recommended updates on each program element.

- **Element 10. Best Management Practices (BMPs) and Conservation Outcomes:** Under the Regional Program, BMPs and desired conservation outcomes have been developed for road maintenance activities. The Regional Forum will annually review and update the BMPs. Local agencies and the Services will review the changes the Regional Forum recommends for adoption.

Figure 7



As shown on Figure 7, if road maintenance were to cease altogether, habitat conditions would decline. With current road maintenance practices, habitat conditions would improve slowly. With implementation of the Regional Program, habitat conditions are expected to improve at a greater rate. Routine road maintenance activities in Washington that conform to the Regional Program are expected to preserve existing habitat function levels and allow natural progression towards PFC where habitat is impaired.

8.0 Literature Cited

Amrhein, C. & Strong, J., 1990. The Effect of Deicing Salts on Trace Metal Mobility in Roadside Soils. *Journal of Environmental Quality* 19, 765 – 772.

Bakkala, R.G. 1970. Synopsis of biological data on the chum salmon, (Oncorhynchus keta) (Walbaum) 1792. FAO Fish Synop. 41, U.S. Fish. Wildl. Serv. Circ. 315, 89 p.

Bjelkas, J. & Lindmark, P., 1994. Pollution of soil and highway runoff due to traffic. *SGI Varia* 420.

Bjornn, T.C. 1971. *Trout and Salmon Movements in Two Idaho Streams as Related to Temperature, Food, Stream Flow, Cover, and Population Density.* Trans. American Fisheries Society. 100.423-428.

Bjornn, T. C., and D. W. Reiser. 1991. Habitat requirements of salmonids in streams. In W. R . Meehan (editor), Influences of forest and rangeland management, p. 83-138. Am. Fish. Soc. Spec. Publ. 19, Bethesda, MD

Burgner, R.L. 1991. Life History of Sockeye Salmon (Oncorhynchus nerka). In: Groot, C. and L. Margolis (eds.). 1991. Pacific Salmon Life Histories. Vancouver, British Columbia: University of British Columbia Press.

Burton, T.A., G.W. Harvey, and M.L. McHenry. 1990. Monitoring the Effects of Nonpoint Sources of Fine Sediment Pollution on Salmonid Incubation and Egg-to-Alevin Survival. Proceedings of the Annual Conference of the Western Association of Fish and Wildlife Agencies. 70: 104-113.

Busby, P., S. Grabowski, R. Iwamoto, C. Mahnken, G. Matthews, M. Schiewe, T. Wainright, R. Waples, J. Williams, C. Wingert, and R. Reisenbichler. 1995. Review of the status of steelhead (Oncorhynchus mykiss) from Washington, Idaho, Oregon, and California under the U.S. Endangered Species Act.

Busby, P.J., T.C. Wainwright, G.J. Bryant, L.J. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status Review of West Coast Steelhead from Washington, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memo. NMFS-NWFSC-27.

Cope, O.B., and D.W. Slater. 1957. Role of Coleman hatchery in maintaining a king salmon run. U.S. Fish Wildl. Serv. Res. Rep., No. 47, 22 p. (Available from Superintendent of Documents, United States Government Printing Office, Washington, D.C.)

Everest, F.H. & D.W. Chapman. 1972. Habitat Selection and Spatial Interaction by Juvenile Chinook Salmon and Steelhead Trout in Two Idaho Streams. Journal of the Fisheries Research Board of Canada. 29.91-100.

Fraser, F.J., P.J. Starr, and A.Y. Fedorenko. 1982. A Review of the Chinook and Coho Salmon of the Fraser River. Can. Tech. Rep. Fish. Aquatic Science. 1126.130.

Gustafson, R.G., T.C. Wainwright, G.A. Winans, F.W. Waknitz, L.T. Parker, and R.S. Waples, 1997. Status Review of Sockeye Salmon from Washington and Oregon. U.S. Department of Commerce, NOAA Technical Memo. NMFS-NWFSC-33.

Healey, M.C. 1991. Life History of Chinook Salmon (Ohcorhynchus tshawytscha). In: Groot, C. and L. Margolis (eds.). 1991. Pacific Salmon Life Histories. Vancouver, British Columbia: University of British Columbia Press.

Helle, J.H. 1984. Age and size at maturity of some populations of chum salmon in North America. In Moiseev, P.A. (ed.), Proceedings of the Pacific Salmon Biology Conference, 1978, p. 126-143. Pacific Sciences Institute of Fisheries and Oceanography (TINRO), 4 Shevccennko Alley, 690600, Vladivostok, USSR.

Johnson, O.W., T.A. Flagg, D.J. Maynard, G.B. Milner, and F.W. Waknitz. 1991. Status Review for Lower Columbia River Coho Salmon. U.S. Department of Commerce, NOAA Technical Memo. NOAA F/NWC 202.

Johnson, O.W., M.H. Ruckelshaus, W.S. Grant, F.W. Waknitz, A.M. Garrett, G.J. Bryant, K. Neely and J.J. Hard. 1999. Status Review of Coastal Cutthroat Trout from Washington, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memo. NMFS-NWFSC-37

Johnson, W.W., W.S. Grant, R.G. Kope, K. Neely, F.W. Waknitz, and R.S. Waples. 1997. Status Review of Chum Salmon from Washington, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memo. NMFS-NWFSC-32.

Kraemer, Curt. 1994. Some Observations on The Life History and Behavior of the Native Char, Dolly Varden, and Bull Trout of the North Puget Sound Region. Washington Department of Fish and Wildlife, Draft Publication.

Lindgren, A., 1996. Asphalt wear and pollution transport. The Science of the Total Environment 189/190, 281-286

Matthews, G.M. and R.S. Waples. 1991. Status Review for Snake River Spring and Summer Chinook Salmon. U.S. Department of Commerce, NOAA Technical Memo. NMFS-F/NWC-200.

McPhail, J.D. and C. Murray. 1979. The Early Life History and Ecology of Dolly Varden in the Upper Arrow Lakes. Unpublished report to the British Columbia Hydro and Power Authority.

Meehan, W.R. and T.C. Bjornn. 1991. Salmonid Distributions and Life Histories. American Fisheries Society Special Publication 19.

Meehan, W. R. (editor). 1991. Influences of forest and rangeland management on salmonid fishes and their habitats. Am. Fish. Soc. Spec. Publ. 19, Bethesda, MD, 751 p.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grand, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memo. NMFS-NWFSC-35.

National Marine Fisheries Service (NMFS) 1996. Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale. Environmental and Technical Service Division. Habitat Conservation Branch.

National Marine Fisheries Service. 1991. Northwest Salmonid Status Reviews. NMFS, Portland, OR.

National Marine Fisheries Service. 1994. A Course Screening Process for Potential Application in ESA Consultations (CRITFC, 1994). Portland, OR.

National Marine Fisheries Service (NMFS). 1996b. Factors for decline: A supplement to the Notice of Determination for West Coast Steelhead under the Endangered Species Act. NMFS Protected Species Branch, Portland, OR, 82 p. + app.x

National Marine Fisheries Service (NMFS). 1998b. Factors Contributing to the Decline of Chinook Salmon: An Addendum to the 1996 West Coast Steelhead Factors for Decline Report, June, 1998. NMFS Protected Resources Division, NMFS 525 N.E. Oregon Street, Suite 500, Portland, OR, 97232

National Marine Fisheries Service (NMFS). 1991a. Final Rule: Endangered status for Snake River Sockeye Salmon. Federal Register [Docket 910379-1256, 20 November 1991] 56(224):58619-58624.

National Marine Fisheries Service (NMFS). 1999. Final Rule: Endangered and Threatened Species; Threatened Status for three Chinook Salmon Evolutionarily Significant Units (ESUs) in Washington and Oregon, and Endangered Status for one Chinook Salmon ESU in Washington. Federal Register [Docket 990303060-9071-02; I.D. 022398C, March 24, 1999]

National Marine Fisheries Service (NMFS). 2000. Final Rule: Designated Critical Habitat: Critical Habitat for 19 Evolutionarily Significant Units of Salmon and Steelhead in Washington, Oregon, Idaho, and California. Federal Register [Docket 990128036-0025-02, I.D. 012100E, February 16, 2000]

National Marine Fisheries Service (NMFS). 1999. The Habitat Approach: Implementation of Section 7 of the Endangered Species Act for Actions Affecting the Habitat of Pacific Anadromous Salmonids. http://www.nwr.noaa.gov/1habcon/abweb/pubs/newjeop9.pdf

National Marine Fisheries Service (NMFS). 1996. The “Man Tech Report;” An Ecosystem Approach to Salmonid Conservation. http://www.nwr.noaa.gov/1habcon/habweb/ManTech/front.htm

National Marine Fisheries Service (NMFS) Northwest Fisheries Science Center publications, including Pacific salmonid status reviews: http://www.nwfsc.noaa.gov/pubs/nwfscpubs.html

ODFW and WDFW. 1998. Status Report Columbia River Fish Runs and Fisheries, 1938-1997.

Oregon Department of Fish and Wildlife Cutthroat Trout website. http://www.dfw.state.or.us/ODFWhtml/InfoCntrFish/PDFs/BKGCoastalCuts.pdf

Randall, R.G., M.C. Healey, and J.B. Dempson. 1987. Variability in length of freshwater residence of salmon, trout, and char. In Dodswell, M.J., et al. (eds.), Common strategies of anadromous and catadromous fishes. Am. Fish. Soc. Symp. 1:27-41.

Reiser & T.C. Bjornn. 1979. Habitat Requirements of Anadromous Salmonids. USFS General Technical Report DNW-96. Pacific Northwest Forest and Rangeland Experiment Station. Portland, OR.

Rieman, B.E. and J.D. McIntyre. 1993. Demographic and Habitat Requirements for Conservation of Bull Trout. U.S. Forest Service General Technical Report INT-302. Intermountain Research Station. Boise, ID.

Roth,L., & Eklund, M., 1999. In a Swedish study showing that the spreading of Zn from tires, brake-lining and pavement is proportional to Average Daily Traffic (ADT).

Salo, E.O. 1991. Life History of Coho Salmon (Oncorhynchus kisutch). In: Groot, C. and L. Margolis (eds.). 1991. Pacific Salmon Life Histories. Vancouver, British Columbia: University of British Columbia Press.

Schreck, C.B., H.W.Li, C.S. Sharpe, K.p. Currens, P.L. Hulett, S.L. Stone, and S.B. Yamada. 1986. Stock identification of Columbia River Chinook salmon and steelhead trout.

Report to U.S. Dep. Energy, Contract DE-AL179-83BP13499, Project 83-451, 184p. Available Bonneville Power Administration, P.O. Box 351, OR 97208

Sneva, John. WDFW biologist. Personal communication. Telephone interview with Steve Mallas, WSDOT biologist on 3/15/99.

Spence, B.C., G.A. Lomnicky, R.M. Hughes, and R.P. Novitzki. 1996. An Ecosystem Approach to Salmonid Conservation. TR-4501-96-6057. Man-Tech Environmental Research Services Corp., Corvallis, Or. (Available from the National Marine Fisheries Service, Portland, OR.)

Steelquist, R. 1992. Field Guide to the Pacific Salmon. Sasquatch Books. Seattle, WA.

United States Department of Fish and Wildlife website for Coastal Cutthroat Trout. http://frwebgate.access.gpo.gov/cgi-in/getdoc.cgi?dbname=1999_register&docid=fr05ap99-35

Waples, R.S., O.W. Johnson, and R.P. Jones, Jr. 1991a. Status Review for Snake River Sockeye Salmon. U.S. Department of Commerce, NOAA Technical Memo. NMFS F/NWC-195.

Waples, R.S., R.P. Jones, Jr., B.R. Beckman, and G.A. Swan. 1991b. Status Review for Snake River Fall Chinook Salmon. U.S. Department of Commerce, NOAA Technical Memo. NMFS F/NWC-201.

Washington Timber/Fish and Wildlife Cooperative Monitoring, Evaluation, and Research Committee. 1993. Watershed Analysis Manual (version 2.0). Washington Department of Natural Resources.

Ward, N., 1990. Multielement Contamination of British Motor way Environments. The Science of the Total Environment, 93, 393-401.

Washington Conservation Commission. 1999a. Washington Conservation Commission's (WCC) Salmon Habitat Limiting Factors Final Report: WRIA 5, Stillaguamish Watershed. July 1999.

Washington Conservation Commission . 1999b. Salmon Habitat Limiting Factors Report for the Puyallup River Basin (WRIA 10). July 1999.

Washington Conservation Commission. 1999c. Salmon and Steelhead Habitat Limiting Factors: WRIA 11. January 1999.

Washington Conservation Commission. 1999d. Salmon Habitat Limiting Factors Final Report: WRIA 13. July 1999.

Washington Conservation Commission. 1999e. Salmon and Steelhead Habitat Limiting Factors: WRIA 18. December 1999.

Washington Conservation Commission. 1999f. Salmon and Steelhead Habitat Limiting Factors in the Western Strait of Juan de Fuca. (WRIA 19).

Washington Conservation Commission. 1999g. Salmon and Steelhead Habitat Limiting Factors in the Willapa Basin report. July 1999. (WRIA 24).

Washington Conservation Commission. 1999h. Salmon and Steelhead Habitat Limiting Factors in WRIA 29. July 1999.

Washington Conservation Commission. 1999i. Salmon Habitat Limiting Factors Final Report: WRIA 30, Klickitat Watershed. July 1999.

Washington Conservation Commission. 1999j. Salmon and Steelhead Habitat Limiting Factors Report for the Entiat Watershed: WRIA 46. July 1999.

Washington Conservation Commission. 2000a. Salmon Habitat Limiting Factors: WRIA 6, Island County. April 2000.

Washington Conservation Commission. 2000b. Salmon Habitat Limiting Factors: WRIA 15 (East). November 2000.

Washington Conservation Commission. 2000c. Salmon and Steelhead Habitat Limiting Factors in the North Washington Coastal Streams of WRIA 20. March 2000.

Washington Conservation Commission. 2000d. Salmon and Steelhead Habitat Limiting Factors: WRIA 26 report. August 2000.

Washington Conservation Commission. 2000e. Salmon and Steelhead Habitat Limiting Factors: WRIA 27. January 2000.

Washington Conservation Commission. 2000f. Salmon and Steelhead Limiting Factors: WRIA 31. January 2000.

Washington Conservation Commission. 2000g. Salmon, Steelhead, and Bull Trout Habitat Limiting Factors: WRIA 48, Methow Watershed. July 2000.

Washington Conservation Commission. 2001a. Salmon and Steelhead Habitat Limiting Factors: WRIA 9, Green River Watershed. January 2001

Washington Conservation Commission. 2001b. Salmon and Steelhead Habitat Limiting Factors: Chehalis Basin and Nearby Drainages, WRIAs 22 and 23. June 2001.

Washington Conservation Commission. 2001c. Salmon and Steelhead Habitat Limiting Factors: WRIA 28 document. March 2001.

Washington Conservation Commission. 2001d. Salmon Habitat Limiting Factors WRIA 32 Walla Walla Watershed. April 2001.

Washington Conservation Commission. 2001e. Salmon and Steelhead Habitat Limiting Factors Report for Foster and Moses-Coulee Watersheds. March 2001. (WRIAs 44 and 50)

Washington State Department of Fisheries, Washington Department of Wildlife, and Western Washington Treaty Indian Tribes, 1993. 1992 Washington State Salmon and Steelhead Stock Inventory (SASSI). Wash. Dep. Fish Wildl., Olympia, 212 p. plus three Appendices: Appendix One—Hood Canal and Strait of Juan de Fuca (December 19994, 424 p.), North Puget Sound (June 1994, 418p.), and South Puget Sound (September 1994, 371 p.) Volumes; Appendix Two—Coastal stocks (August1994, 587 p.); and Appendix Three—Columbia River stocks (June 1993, 580 p.). Available Washington Department of Fish and Wildlife, 600 Capitol Way N., . Olympia, Washington 98501-1091.

Washington Department of Fish and Wildlife (WDFW). 1998a. 1998 Washington salmonid stock inventory, coastal cutthroat trout appendix. Wash. Dep. Fish. Wildl., Olympia, WA. 280p. (Available from WDFW, P.O. Box 43151, Olympia, WA 98504)

Washington State Department of Natural Resources (DNR). December 2000. Changing Our Water Ways: Trends in Washington's water systems. Wash. Dep. DNR, Communications Product Development, P.O. Box 47040, Olympia, WA 98504-7040

Washington State Department of Transportation (WSDOT), Environmental Affairs Office. March, 2001. WSDOT Programmatic Biological Assessment for Aquatic Species. Olympia Washington.

Washington State Governor's Salmon Recovery Office. September 21, 1999. Extinction is not an Option: Statewide Strategy to Recover Salmon. Contact the Governor's Salmon Recovery Office at www.governor.wa.gov/esa.

Weitkamp, L.A., T.C. Wainwright, G.J. Bryant, G.B. Milner, D.J. Teel, R.G. Kope, and R.S. Waples. 1995. Status Review of Coho Salmon from Washington, Oregon, and California. U.S. Department of Commerce. NOAA Technical Memo. NMFS-NWFSC

Wydoski, R.S., and R.R. Whitney. 1979. Inland fisheries of Washington. Univ. Washington Press, Seattle.

Acronyms

AHB	Area Habitat Biologist
Al	Aluminum
BAS	Best Available Science
BKD	Bacterial Kidney Disease
BMP	Best Management Practices
Cd	Cadmium
Ce	Cerium
Co	Cobalt
Cr	Chromium
Cu	Copper
CWT	Coded Wire Tag
ESA	Endangered Species Act
ESHB	Engrossed Substitute House Bill
ESU	Evolutionarily Significant Unit
Fe	Iron
FR	Federal Register
H&LP	Highways and Local Program
HPA	Hydraulic Project Approval
LWM	Large Woody Material
Mg	Magnesium
Mn	Manganese
Mo	Molybdenum
MPI	Matrix of Pathways and Indicators
Ni	Nickel
NMFS	National Marine Fisheries Service
ODFW	Oregon Department of Fish and Wildlife
Pb	Lead
Pd	Palladium
PFC	Properly Functioning Conditions
Pt	Platinum
R/W	Right-of-Way
RCW	Revised Code of Washington
Rh	Rhodium
ROW	Right-of-Way
SASSI	Salmon and Steelhead Stock Inventory
Services	National Maine Fisheries Service & US Fish and Wildlife Service
STE	Survival-to-Emergence
SW	South West
TAG	Technical Advisory Group
Ti	Titanium
USFS	U.S. Forest Service

USFWS	U.S. Fish and Wildlife Service
V	Vanadium
W	Tungsten
WDFW	Washington State Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation
Zn	zinc

Glossary

Alevin
Life-history stage of a salmonid immediately after hatching and before the yolk-sac is absorbed. Alevins usually remain buried in the gravel in or near the egg nest (redd) until their yolk-sac is absorbed when they swim up and enter the water column.

Allopatric
Occurring in different geographic regions. See parapatric and sympatric.

Anadromous
Exhibiting a behavior involving migrations from freshwater to seawater and back to freshwater to spawn.

Coded-wire tag (CWT)
A small piece of wire, marked with a binary code, that is normally inserted into the nasal cartilage of juvenile fish. Because the tag is not externally visible, the adipose fin of coded wire-tagged fish is removed to indicate the presence of the tag. Groups of thousands to hundreds of thousands of fish are marked with the same code number to indicate stock, place of origin, or other distinguishing traits for production releases and experimental groups.

Evolutionarily significant unit (ESU)
A "distinct" population of Pacific salmon, and hence a species, under the Endangered Species Act.

Fry
Stage in the salmonid life history when the juvenile has absorbed its yolk-sac and leaves the gravel of the redd to swim up into the water column. The fry stage follows the alevin stage and in most salmonid species is followed by the parr, fingerling, and smolt stages.

Hatchery
Salmon hatcheries use artificial procedures to spawn adults and raise the resulting progeny in fresh water for release into the natural environment, either directly from the hatchery or by transfer into another area.

Iteroparous
Reproducing repeatedly, or more than once in a lifetime. In the genus *Oncorhynchus,* only *O. Clarki* and *O. mykiss* are iteroparous; all other species are semelparous (i.e., all individuals die after spawning).

Natal streams
Relating to the time or place of one's birth. Birth streams.

Parapatric
Having some geographic overlapping of distributions with the potential for gene flow between populations. See sympatric and allopatric.

Potamodromous
Exhibiting a behavior involving migrations into smaller river tributaries for spawning and rearing. Potamodromous behavior does not involve migrations out of fresh water. Also called fluvial – ad fluvial (Trotter et al. 1993). Potamodromous behavior is common among interior cutthroat trout (*O. clarki* subspp.).

Progeny
Descendants or offspring.

Redd Counts
Most salmonids deposit their eggs in nests called redds, which are dug in the streambed substrate by the female. Most redds occur in predictable areas and are easily identified by an experienced observer by their shape, size, and color (lighter than surrounding areas because silt has been cleaned away).

Spawning surveys utilize counts of redds and fish carcasses to estimate spawner escapement and identify habitat being used by spawning fish. Annual surveys can be used to compare the relative magnitude of spawning activity between years.

Resident
Occupying headwater reaches; may disperse locally, but generally considered non-migratory. Also called fluvial (Trotter et al. 1993).

Salmon and Steelhead Stock Inventory (SASSI)
A cooperative program by WDFW and WWTIT to inventory and evaluate the status of Pacific salmonids in Washington State.

Sea-Run
Synonymous to anadromous but is usually used only in reference to the anadromous component of species such as *O. clarki* and *O. mykiss* that commonly have both an anadromous and non-anadromous life history form.

Semelparous
The condition in an individual organism of reproducing only once in a lifetime.

Smolt
Verb – the physiological process that prepares a juvenile anadromous fish to survive the transition from fresh water to salt water

Noun – A juvenile anadromous fish which has smolted.

<u>Streams</u>
" 'Watercourse' and 'river or stream' means any portion of a channel, bed, bank, or bottom water ward of the ordinary high water line of waters of the state including areas in which fish may spawn, reside, or through which they may pass, and tributary waters with defined bed or banks, which influence the quality of fish habitat downstream. This includes watercourses which flow on an intermittent basis or which fluctuate in level during the year and applies to the entire bed of such watercourse whether or not the water is at peak level. This definition does not include irrigation ditches, canals, storm water runoff devices, or other entirely artificial watercourses, except where they exist in a natural watercourse which has been altered by humans" WAC 220-110-020 (41).

<u>Sympatric</u>
Occupying the same geographic area. See paratactic and allopatric.